

3

Affected Environment

3.1 Topography, Geology and Soils

The Study Area lies geographically in what has been called the Seaboard Lowland section of the New England physiographic province, one of the subdivisions of the Appalachian Highlands (Fenneman, 1938). The area is generally composed of low rolling hills that rise 100 to 300 feet above the river valleys. There is no pronounced topographic trend, although in the central portion of the Study Area there is a somewhat northwesterly trend. The lowest point in the Study Area is along the Massachusetts border in Salem -- approximately 110 feet above sea level. The highest point, Warner Hill, is in central Derry at 605 feet above sea level. Jenny's Hill in Windham reaches 500 feet, while the area near the Bridge Street overpass on I-93 in Windham is 510 feet above sea level.

The project lies entirely within the drainage basin of the Merrimack River, which flows southerly on the western edge of several of the towns in the Study Area. Several tributaries drain the Study Area: Cohas and Little Cohas Brooks in the northern third, Beaver Brook in the middle third, and Golden Brook and the Spicket River system in the southern third. Lakes and ponds of various sizes are present in the Study Area and range in elevation from approximately 150 to 290 feet above sea level. The largest, Massabesic Lake in Manchester, is 251 feet elevation. It flows into Cohas Brook. Beaver Lake in Derry is 287 feet above sea level and drains into Beaver Brook. Cobbett's Pond at 177 feet elevation in Windham drains into Golden Brook. Numerous ponds and lakes are located in the Spickett River watershed including Canobie Lake (elevation 219 feet), Seavey Pond (246 feet), Shadow Lake (159 feet), Millville Lake (136 feet) and Arlington Mill Reservoir (160 feet).

Much of the present landscape character in the Study Area is the result of continental glaciation that occurred between 10,000 and one million years ago during the Pleistocene Epoch. As the glacier moved from the northwest to southeast, it scoured and smoothed the underlying bedrock, picking up soil, rock, and other debris. These materials were later deposited as glacial drift when the ice sheet melted.

The bedrock of the Study Area is metamorphic rock consisting of schists and granulites that are probably of the Silurian and Devonian age, and plutonic gneisses of the Late Devonian age. Most of the bedrock, from the Massachusetts border almost to the Londonderry-Manchester border, belongs to the Silurian Merrimack Group. The northernmost portion of the Study Area is underlain by Late Devonian Massabesic gneiss that consists chiefly of pink biotite-microcline gneiss.

Plutonic rocks form several bodies in the Study Area. The Ayer granodiorite forms one five-mile long body that intersects I-93 at the Windham-Salem boundary near Canobie Lake. A foliated binary granite body 11 miles long intersects I-93 in Londonderry. The rocks in the Study Area dip very steeply and are part of a synclinal structure trending northeast. The synclinal axis of this structure transects the Study Area.

In some places glacial till was "dumped" in oval-shaped hills called drumlins, one of which is located just north of Exit 2 on the south side of I-93. Ice-contact deposits were formed within and alongside glaciers that moved through the valleys in the Study Area. Glacial outwash and stratified drift deposits are found in the Beaver Brook and Cohas Brook stream valleys of the Study Area.

Several pro-glacial lakes formed in the larger stream basins of the Study Area including Glacial Lake Methuen (near Exit 2), Glacial Lake Golden Brook (near Cobbett's Pond), and Glacial Lake Derry (in the Bear Brook Valley beginning just south of Exit 4 and extending north along the I-93 corridor). As the meltwater streams entered these lakes, the fine-grained sediments settled out forming sequences of sand, silt, and clay deposits -- referred to as glacio-lacustrine deposits up to 30 feet in thickness. These deposits overlay the till and outwash deposits.

The Study Area also contains swamp deposits of the Halorene age that contain muck, peat, silt and sand. These are scattered throughout the Study Area, overlying the glacial till. These deposits, usually five to ten feet thick, formed from accumulating organic materials in depressional areas.

Soils series as described in the soil survey maps produced by the Natural Resource Conservation Service (NRCS) for Rockingham County (unpublished) and Hillsborough County (Eastern Part) were each grouped into the categories based on predominant parent material or land-use. Seven major soil categories were identified in the I-93 Study Area (**Figure 3-1**). These major parent material or land use categories are:

Insert Figure 3-1:

3-1 Project Area Soils

(Sheet 1 of 2)

Insert Figure 3-1:

3-1 Project Area Soils

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Glacial Till
Glacio-Fluvial Deposits
Marine/Lacustrine
Alluvial Deposits
Peat
Gravel pits
Urban or Made Land

Soils derived from glacial till are the most common type identified within the I-93 corridor area. Glacial till, which comprises approximately 62.3% of the Study Area, is spread uniformly across the region and generally provides the base from which the other soil parent materials were derived following glaciation.

Glacial-fluvial soils cover 17.2% of the Study Area. Glacial-fluvial deposits are the sandy or silt loam textured soils that developed from eroded material carried, then deposited by glacial streams and floods. Soils derived from glacial-fluvial deposits occur in three major bands across the region. Each of these bands occur in proximity to the major river systems located in the area (Cohas Brook, Beaver Brook and Porcupine/Policy Brook). The well drained Canton and excessively drained Windsor series are common around Cohas Brook. The somewhat poorly to poorly drained Pipestone series dominates the glacial-fluvial soils around Porcupine and Policy Brooks in the Salem area. While the moderately well drained Deerfield and excessively drained Hinckley soils can be found around Beaver Brook in the Londonderry/Derry area.

Urban or made land makes up 6.2% of the Study Area. Urban or made land includes any areas identified in the soil series maps that consist mainly of sandy or gravelly fill material that has been placed on terraces, floodplains, and uplands. The amount of fill that may have been placed varies from 20 inches to 20 feet. Similarly, urban or made land also includes any areas where 85% or more of the land area is covered with buildings, asphalt or concrete. Typically, these areas include business districts, industrial parks and shopping centers.

Gravel pit areas, which include open excavations from which gravel or sand have been removed, make up 2.0% of the Study Area. Excavations of granite, areas commonly identified as quarries, are also included under this category. Most pit areas range in size from 2 to 40 acres.

3.2 Surface Water Resources

Surface water resources within the Study Area consist of lakes, ponds, streams, and the watersheds that drain into them. Surface water quality regulations are administered by the New Hampshire Department of Environmental Services, Water Supply and Pollution Control Division. Water Quality Standards classify waters as A, B, or C and designate uses and water quality criteria for each class. All major surface water resources within

the Study Area are classified A or B. Class A is the highest classification and designates water quality that is uniformly excellent and acceptable for water supply uses. Discharges of polluting substances into Class A waters are prohibited. Class B designates water quality that is of high aesthetic value and acceptable for swimming and other recreation and as fish habitat. Discharges of polluting substances into Class B waters without adequate treatment are prohibited.

3.2.1 Watersheds

The following five watershed systems are within the Study Area and shown on **Figure 3-2**:

- Spicket River Watershed,
- Golden Brook Watershed,
- Beaver Brook Watershed,
- Little Cohas Brook Watershed, and
- Cohas Brook Watershed

The Spicket River Watershed includes most of the Study Area south of Exit 3 on I-93. It contains the Spicket River, Policy Brook, Porcupine Brook, Flat Rock Brook/Hittytity Brook, World End Brook, World End Pond, Canobie Lake, Mitchell Pond, Shadow Lake, and Ezekial Pond.

The Golden Brook Watershed, which ultimately joins with the Beaver Brook Watershed in Massachusetts, encompasses much of the central portion of Windham. It includes Collins Brook, Golden Brook, Cobbetts Pond, Rock Pond, and Moeckle Pond.

The Beaver Brook Watershed encompasses much of Londonderry and Derry in the Study Area. This watershed contains Beaver Lake, Hoods Pond, Scobie Pond, Beaver Brook, West Running Brook, and Shields Brook.

The Little Cohas Brook Watershed encompasses most of northern Londonderry and extends just east of I-93 near the Exit 5 Exit. This watershed contains Little Cohas Brook and an unnamed surface water body located where I-93 crosses the Boston and Maine Railroad.

The Cohas Brook Watershed is the most northern in the Study Area, encompassing much of the southerly and easterly portions of Manchester and parts of northern Londonderry and Derry. It contains Lake Massabesic, Long Pond, Long Pond Brook, Crystal Lake, and Pine Island Pond. Cohas Brook is the principal brook in the watershed. The lower portion of this stream is referred to as Great Cohas Brook.

Insert Figure

3-2 Surface Water Resources

(Sheet 1 of 2)

Insert Figure

3-2 Surface Water Resources

(Sheet 2 of 2)

3.2.2 Lakes and Ponds

This section identifies the standing water habitats (lentic habitats) that may be impacted by the highway improvements identified by this project (see Figure 3-2).

Canobie Lake

Canobie Lake is located east of I-93 between Exits 2 and 3 on the Windham/Salem town line. This lake is classified as a Class A waterbody because it currently serves as the municipal water supply for the Town of Salem. The water intake and pumping station are located on the northeast shore. The lake's surface area is approximately 1,400 acres. The outlet of Canobie Lake is Policy Brook, located on the east shore. Large portions of the shoreline are heavily developed, including an amusement park on the east shore.

Cobbetts Pond

Cobbetts Pond is located southwest of Exit 3 in the Town of Windham, NH, within an area bounded on three sides by NH 111, NH 111A and I-93. The Study Area includes the northeast corner of the pond but the northern portion of its watershed is within 500 feet of I-93. The Pond has a surface area of approximately 345 acres with a total watershed area of about 2,050 acres. The entire I-93 and NH 111 interchange area and approximately 0.75 miles of both the northbound and southbound lanes of I-93 north of the interchange lie within the watershed. A small unnamed stream flows through the Exit 3 area and subsequently empties into Cobbetts Pond. Much of the roadway runoff drains into this small stream. Cobbetts Pond is oriented in a north-south direction with an upper and lower basin. The outlet is Golden Brook located on the southwest shore. The pond is classified as a Class B waterbody and is not currently used as a municipal water supply. Cobbetts Pond is used extensively for recreation purposes. Homes and cottages surround the entire pond, leaving very little open shoreline.

Bridge Street Pond

This is a small unnamed pond located just west of I-93, approximately 2.2 miles north of Exit 3 near Bridge Street in Windham.

Hoods Pond

Hoods Pond is located in downtown Derry where a park is situated on its shore. This pond receives drainage from Stonehenge Road Tributary.

Unnamed Ponds South of Exit 5

These unnamed waterbodies are located south of Exit 5 on opposite sides of I-93. Although close to I-93, they do not appear to be receptors of road drainage.

Exit 5 Pond

This unnamed pond is located directly northeast of Exit 5.

Wheeler Pond

Wheeler Pond is located approximately 200 feet east of I-93, north of NH 102 in Londonderry. Wheeler Pond was previously drained, by removal of the dam, but has recently been re-established in conjunction with construction of an adjacent restaurant.

Crystal Lake

Crystal Lake is located approximately 1,000 feet west of I-93 just south of the junction with I-293 in Manchester and is used for recreational purposes by the City of Manchester. The NHDES has categorized this lake as eutrophic.

Pine Island Pond

Pine Island Pond is outside the I-93 Study Area (approximately 2.5 miles west of I-93), but potentially receives drainage from I-93 via Cohas Brook. The NHDES has categorized this lake as eutrophic.

Lake Massabesic

Lake Massabesic is approximately 2.0 miles northeast of the I-93/I-293 Interchange. It is upstream of I-93, and thus does not receive any drainage from the highway corridor. It is a Class A waterbody and serves as the major water supply for the greater Manchester area. In addition to providing water for almost all the residential, commercial, industrial, and institutional uses of the city, Lake Massabesic provides water for large areas of Londonderry and Derry.

The lake is located on the Manchester-Auburn border and has a surface area of approximately 2,500 acres, a gross storage capacity of nearly fifteen billion gallons and a safe dependable yield of 20.5 million gallons per day.

The NH Division of Water Supply and Pollution Control (DWSPC) has adopted a set of strict guidelines to ensure continued high water quality. In addition, to further protect the water quality, the Manchester Water Works owns and controls approximately 8,000 acres of the watershed in Manchester, Auburn, Candia, Chester, and Hooksett. The outlet for the lake is Cohas Brook at its southwestern shore.

3.2.3 Streams and Tributaries

There are numerous stream or brook crossings in the Study Area. In addition, there are several streams adjacent to the current I-93 right-of-way that may be impacted by an expansion or improvement of this highway (see Figure 3-2).

Policy Brook

Beginning at the southern end of the Study Area the first stream to be encountered is Policy Brook. Policy Brook runs parallel to I-93 within 500 feet east of the northbound lane for approximately 1.0 mile, beginning just south of Exit 1 and extending to the south where it joins the Spicket River which flows south into Massachusetts. Policy Brook is rated as a Class B stream. Within New Hampshire, the Brook is crossed by ramps from I-93 northbound, accessing the Salem Rest Area. It appears that the Brook may have had a meandering alignment, but was relocated and straightened to accommodate the construction of the current layout for I-93.

Exit 1 Tributary

This unnamed stream crosses I-93 within Exit 1 just south of the southbound on/off flyover. It then joins Porcupine Brook on the south side of Rockingham Park Boulevard. Portions of this tributary appear to have been relocated and straightened to accommodate the layout for Rockingham Park Boulevard.

Porcupine Brook

Porcupine Brook first crosses the southbound lane of I-93 approximately 0.8 mile south of Exit 2 then runs southerly between the two lanes in the median area for approximately 0.4 mile before crossing the northbound lane just north of NH 38 (Lowell Road). The brook then crosses and runs southerly until it joins with the Exit 1 Tributary described above. Porcupine Brook is a Class B stream. Portions of this brook (in the median) appear to have been relocated and straightened to accommodate the layout for I-93.

Exit 2 Tributary

This unnamed stream crosses the northbound lane at approximately the same location as the southbound lane crossing of Porcupine Brook. It then joins Porcupine Brook in the median. This tributary parallels the northbound lane in a meandering fashion for 0.3 mile. At this point it crosses both the north and southbound lanes and then parallels the southbound lane for approximately 0.5 mile running through the western cloverleaf loop of Exit 2 where it appears to originate. Portions of this tributary appear to have been relocated and straightened to accommodate the layout for I-93.

Canobie Lake Tributary

This unnamed stream is located at the northwest end of Canobie Lake. It originates within 100 feet of NH 111-A and outlets into Canobie Lake.

Exit 3 East Tributary

This unnamed stream originates from two small ponds 1,200 feet east of I-93. A branch joins the tributary within 200 feet of the highway before it crosses the northbound lane of I-93 just north of Exit 3. It then crosses NH 111 (Indian Rock Road) in the median area of the interchange and the southbound lane of the highway, as well as the southbound entrance/exit ramps for Exit 3. This tributary flows westerly into the northeast end of Cobbetts Pond.

Exit 3 North Tributary

This unnamed stream crosses the northbound lane about 0.3 mile north of the Exit 3 East Tributary. It also crosses NH 111 (Indian Rock Road) just beneath the southbound lane of I-93 at Exit 3 before it joins the Exit 3 East Tributary just east of the southbound entrance/exit ramps of the Interchange.

Tributary Opposite Jennys Hill

This unnamed stream arises within 200 feet of the southbound lane of I-93 approximately 1.0 mile north of Exit 3, opposite Jennys Hill. This tributary flows southwesterly crossing NH 111 (Indian Rock Road) and finally joins Golden Brook near the southwestern end of Cobbetts Pond.

Tributary A - Golden Brook (identified on the Windham FIRM maps)

This unnamed stream arises within 200 feet of the southbound lane of I-93, approximately 0.8 mile north of the Tributary Opposite Jennys Hill. It flows southwesterly for approximately 1.1 miles and joins the Tributary Opposite Jennys Hill before flowing into Golden Brook.

Morrison Road Tributary

This unnamed stream appears to arise from a small pond just west of I-93 approximately 2.4 miles north of Exit 3. This tributary crosses I-93 and flows easterly, crossing and then running parallel to Morrison Road for approximately 1.0 mile where it enters Mitchell Pond.

Windham Depot Tributary

This unnamed stream arises within 100 feet east of I-93, 0.4 mile north of Morrison Road Tributary and just south of Windham Depot. It flows easterly and southeasterly for approximately 0.7 mile where it joins Flatrock Brook.

Derry South Tributary

This unnamed stream arises just west of I-93, approximately 0.5 miles north of the Derry/Windham town line. It flows southwesterly and ultimately discharges to Beaver Brook.

Derry North Tributary

This unnamed stream arises just east of I-93 across from the Derry South Tributary. It flows northeasterly and ultimately discharges to Beaver Brook.

Beaver Brook

Beaver Brook crosses I-93 near the Derry Sewage Lagoons and the Derry/Londonderry town line approximately 0.8 mile south of Exit 4. Beaver Brook, one of the major streams in the Study Area, is designated as a Class B waterbody.

Pillsbury Road Tributary

This unnamed stream also known as Tributary D – Beaver Brook (identified on the Londonderry FIRM maps) originates adjacent to the west side of the I-93 corridor and parallels I-93 within 100 feet of the highway for approximately 1.0 mile before it crosses the highway at the intersection with Pillsbury Road. It then flows southeasterly, eventually entering Wheeler Pond near Exit 4. Portions of this tributary may have been relocated and straightened to accommodate the construction of I-93 as it exists today.

Stonehenge Road Tributary

This unnamed stream crosses I-93 at the same location as Stonehenge Road and then flows easterly and southeasterly for approximately 2.3 miles, where it flows into Hoods Pond.

Cohas Brook

Due to the alignment of I-93 and the flow pattern of Cohas Brook, this water body has a potential for major impact from any improvements to I-93 in the northern portion of the Study Area. The brook originates from several tributaries in Londonderry, just south of the Londonderry/Manchester municipal line. The brook flows north, crossing under the northbound barrel of I-93, approximately 0.5 miles north of the municipal line. From

there it flows north within the median area of I-93 until just south of the I-93/Bodwell Road crossing. Cohas Brook then crosses I-93 northbound and continues to the north where it is joined by the outflow tributary from Massabesic Lake and another tributary from the north. The brook then flows due west, crossing under the southern portion of the I-93/I-293/NH 101 Interchange and outletting into Pine Island Pond, which flows directly into the Merrimack River. Cohas Brook is designated as a Class B waterbody.

Long Pond Brook

Long Pond Brook is a tributary of Cohas Brook. It crosses the northbound lane of I-93 from the east and joins Cohas Brook, approximately 0.5 mile north of the southerly Cohas Brook crossing. Long Pond Brook outlets from Long Pond, which is approximately 0.8 mile east of I-93.

3.2.4 Wild, Scenic, or NH Designated Rivers

There are no rivers, brooks, or streams in the Study Area either under study or currently listed with the National Wild and Scenic Rivers Program. None of the rivers, brooks or streams in the Study Area are under study either for protection, or are currently designated, as natural, rural, or community rivers under the New Hampshire Rivers Management and Protection Program under RSA Chapter 483.

3.2.5 Essential Fish Habitat

The Magnuson-Stevens Fishery Conservation and Management Act (MSA) established a requirement to describe and identify “essential fish habitat” (EFH) in each federal fishery management plan. EFH is defined as “those waters and substrates necessary to fish for spawning, breeding, feeding, or growth to maturity”. “Waters” include aquatic areas and their associated physical, chemical and biological properties.

Fishery Management Councils determine which areas will be designated as EFH. The MSA requires all federal agencies to consult with the National Marine Fisheries Service (NMFS) on all proposed federal actions that may adversely affect EFH.

Requirements for NMFS consultation and compliance will be evaluated during future phases of environmental documentation for the proposed I-93 improvements.

3.3 Floodplains

Floodplains within the Study Area are shown on Flood Insurance Rate Maps for each of the Study Area communities. The limits of the 100-year floodplains are depicted on **Figure 3-3** for the Study Area. Also shown are the watercourse reaches with designated Regulatory Floodways.

Salem, Windham, Derry, and Londonderry have adopted regulations governing development within the areas designated as special flood hazard areas on FEMA's Flood Insurance Rate Maps (FIRM). The regulations generally require a local permit for work within the 100-year floodplain, and provide for development to meet standards consistent with federal requirements for construction within floodplains. In general, the project proponent must demonstrate that a proposed action will not cause more than a one-foot increase in the existing 100-year flood level.

In addition, all five municipalities in the Study Area have local ordinances prohibiting encroachments within the "Regulatory Floodway" that would result in any increase in flood levels within the community during the base (100-year) flood discharge. The "Regulatory Floodway" is generally defined as the channel of a river or other watercourse and the adjacent land areas that must be reserved to discharge the base flood without cumulatively increasing the water surface elevation more than one foot at any point. In Salem, Windham, Derry and Londonderry, along watercourses that do not have a designated Regulatory Floodway, no encroachment is permitted within specified zones on each community's FIRM unless the applicant demonstrates that the cumulative effect of the proposed development, when combined with all existing and anticipated development, will not increase the water surface elevation of the base flood more than one foot at any point in the community.

Potential floodplain crossings or encroachments that may be of concern occur at the Spicket River, Policy Brook, and Porcupine Brook in Salem; Canobie Lake, Cobbetts Pond, and a tributary of Golden Brook in Windham; Beaver Brook near the Derry/Londonderry town line; two tributaries to Beaver Brook, one in Derry and one in Londonderry; and Cohas Brook and Long Pond Brook in Manchester.

Of the floodplains in the Study Area, the following may involve encroachment or crossing of regulatory floodways:

- Spicket River in Salem;
- Beaver Brook in Derry and Londonderry;
- Tributary D – Beaver Brook in Londonderry;
- Cohas Brook in Manchester.

A brief description of major floodplains that may be affected follows:

Spicket River at Southern Boundary of Salem

The 100-year floodplain in this vicinity varies in width up to approximately 1,600 feet, with a 300-foot floodway. The drainage area at this point is 61.6 square miles, with a base flood peak discharge of 1,900 cubic feet per second (cfs), and a mean floodway velocity of 1.1 feet per second (fps). The base flood elevation data are available from profiles furnished in the Flood Insurance Study for the Town of Salem.

Policy Brook and Porcupine Brook in Salem

Floodplain descriptive data are not available for the reaches of these brooks located within the existing I-93 corridor. Also, floodplain elevation data are not indicated on the FIRM panels for these reaches.

Canobie Lake and Cobbetts Pond, Windham

No descriptive data are furnished for the Canobie Lake or Cobbetts Pond floodplains, and elevation data are not listed for these areas in the Flood Insurance Study for Windham or on the FIRM panel.

Tributary A - Golden Brook

Existing I-93 crosses the upper reach of this tributary. The floodplain varies in width, from approximately 200 to 450 feet at the existing embankment crossings. Elevation data are not given on the FIRM for this reach.

Insert Figure

3-3 Floodplains

(Sheet 1 of 2)

Insert Figure 3-3:

3-3 Floodplains

(Sheet 2 Of 2)

Beaver Brook at Derry/Londonderry Town Line

The 100-year floodplain at this location varies in width, from roughly 500 to 900 feet on the FIRM panels for Derry and Londonderry. The regulatory floodway is approximately 300 feet in width.

The drainage area of Beaver Brook at this point is 26.3 square miles, and the base flood peak discharge is 1860 cfs, with a floodway mean velocity of 1.5 fps. Base flood elevations for this reach are identified in the Flood Insurance Studies for Derry and Londonderry.

Wheeler Pond in Londonderry

The 100-year floodplain to Wheeler Pond consists of two tributary (south-flowing) watersheds in the vicinity of Londonderry Road and Dickey Street. The floodplain boundaries all lie within 1,000 feet and are parallel to I-93 study corridor.

Pillsbury Road Tributary (Tributary D) of Beaver Brook in Londonderry

The 100-year floodplain of this reach lies to the east of I-93 and crisscrosses Londonderry Road. The floodplain and floodway are variable in width in this vicinity (refer to **Figure 3.3**). At the closest point to I-93, the base floodplain is generally 100 to 250 feet wide, with a regulatory floodway of 10 to 20 feet wide. Floodway mean velocity ranges from 2.3 to 7.9 fps, with the upper value occurring at the uppermost limit of the Tributary D drainage area. At the town limits, this tributary has a drainage area of 1.5 square miles and a base flood peak discharge of 245 cfs.

Cohas Brook (Great Cohas Brook) in Manchester

The Cohas Brook has an extensive floodplain area intertwined with the interchange of I-93 with I-293/NH 101. The floodplain configuration is complex (see **Figure 3-3**). The regulatory floodway at the crossing by the I-93 embankments is 125 to 150 feet wide, with an estimated mean velocity for the 100-year flood of 2.6 to 2.9 fps. The nearest downstream location for which flood discharge data is furnished in the Flood Insurance Study is South Willow Street, where the contributing watershed is about 66 square miles, and the base flood discharge is 3600 cfs. Floodplain elevation data are provided for the Great Cohas Brook in the Flood Insurance Study for Manchester.

3.4 Groundwater Resources

Groundwater resources within the Study Area consist of stratified drift aquifers, bedrock aquifers, and the municipal, community, and private supply wells that pump water from them. These groundwater resources are regulated under the New Hampshire Groundwater Protection Act, 1991.

Groundwater resources within the Study Area consist of both stratified-drift aquifers and bedrock aquifers. The most productive aquifers in the Study Area are composed of stratified-drift deposits. Stratified-drift aquifers within the Study Area are depicted in **Figure 3-4** (partially compiled from Cotton, 1979 and Stekl and Flanagan, 1992). The potential yields of groundwater from areas within each aquifer are mapped according to transmissivity values. This information was taken from “Groundwater Resources of the Lower Merrimack River Valley, South Central New Hampshire” (Weigle, 1968).

Notable within the Study Area are pro-glacial stratified-drift deposits, known as valley trains. These consist of valleys filled with stratified drift deposited by meltwater that drained from glaciers upvalley. Valley trains are the prominent feature of the Beaver Brook aquifer, running from Derry to the southwest between Londonderry and Windham and the Golden Brook aquifer (located outside the Study Area) in Windham. This latter aquifer has been the focus of a detailed hydrologic evaluation because of its potential importance as a public water supply (Stekl and Flanagan, 1992).

Bedrock aquifers contain water available to wells only in fractures in the otherwise crystalline rock. Bedrock aquifers are used for private and public water supplies throughout the Study Area and municipal and community bedrock water supply wells are located in the towns of Derry, Windham, and Salem. Although bedrock aquifers currently serve as private and public water supplies, variation in the density and location of water-bearing fractures make methodical prospecting for large production wells difficult.

Insert Figure

3-4 Groundwater Resources

(Sheet 1 of 2)

Insert Figure

3-4 Groundwater Resources

(Sheet 2 of 2)

Community water supply wells in the Study Area are located on **Figure 3-4**. Community wells are operated either by a municipal entity or a group of private citizens who share the cost of installing and operating the wells and treating and delivering the water. Private wells are owned, operated, and paid for by individual residents. Private wells are not shown on **Figure 3-4**.

Derry is supplied by several town-owned and privately owned community well systems. Only the privately owned community well, near the intersection of Gordon and Thomas Streets, is near the Study Area. The remaining residences rely principally on private bedrock water supply wells. Derry has created a *Groundwater Resources Conservation Distric* (Figure 3-4).

Windham has two small community water supply systems operated by the Pennichuck Water Company, which bought out Southern New Hampshire Water Co., Inc. The major water supply well near the Study Area is located approximately 2,500 feet south of Exit 3 and approximately 300 feet east of the I-93 northbound barrel. This supply is a cluster of wells feeding homes along the western shore of Canobie Lake. The other is located outside the Study Area (4,400 feet west of I-93 and just south of NH 111A) and not shown on **Figure 3-4**. Otherwise, the majority of water supplies in Windham are private wells. In association with the Town of Salem, Windham has created *Wellhead and Watershed Protection Areas* (**Figure 3-4**).

Salem's principal water supply is Canobie Lake. However, the town has two (currently inactive) municipal wells: the Turner Well, located approximately 3,000 feet west of Exit 1, and the Donigan Well located approximately 3,000 feet west of Exit 2. These wells may be activated in the future. Since neither well is in the Study Area, they are not shown on **Figure 3-4**. In association with the Town of Windham, Salem has created *Wellhead and Watershed Protection Areas* (**Figure 3-4**).

Many residential properties within the towns of Londonderry, Derry, Windham, and Salem have private drinking water wells near the Study Area, most of which are bedrock wells.

Manchester and Londonderry are both supplied by the Manchester Water Works and the Pennichuck Water Company that bought out Southern New Hampshire Water Co., Inc. The source of water for both municipalities is Massabesic Lake. Manchester has no municipal wells.

3.5 Farmlands

The four categories of farmland addressed in the Farmland Protection Policy Act (FPPA) of 1984 include prime farmland, unique farmland, farmland of statewide importance, and farmland of local importance. In addition, active farmland or agriculture areas are discussed. Each farmland category is described below:

- **Prime Farmland** is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops. It has the soil quality, growing season, and moisture supply needed to economically produce a sustained high yield of crops when the land is treated and managed using acceptable farming methods. Prime farmland produces the highest yields with minimal inputs of energy and economic resources and causes the least damage to the environment. Prime farmland usually has an adequate and dependable supply of moisture from precipitation or irrigation. It also has a favorable temperature and growing season and acceptable acidity or alkalinity. It has few or no rocks and is permeable to water and air. Prime farmland is not excessively erodible or saturated with water for long periods and either does not flood frequently or is protected from flooding. The slope ranges mainly from 0 to 8 percent. Prime farmland may now be in crops, pasture, or woodland, but not urban and built-up land or water areas. It must either be used for producing food or fiber or be available for these uses.
- **Unique Farmland** is land other than prime farmland that is used for the production of specific high value food and fiber crops. It has the special combination of soil quality, location, growing season, and moisture supply needed to economically produce sustained high quality and/or high yields of a specific crop when treated and managed according to acceptable farming methods. Examples of such crops in New Hampshire are apple orchards, lowbush blueberries, vegetable truck gardens, and maple sugar groves.
- **Farmland of Statewide Importance** is land, in addition to prime and unique farmlands, that is of statewide importance for the production of food, feed, fiber, forage, and oilseed crops. Generally, these farmlands include those areas that are nearly prime farmland and that economically produce high yields of crops when treated and managed according to acceptable farming methods.
- **Farmland of Local Importance** includes certain additional farmlands for the production of food, feed, fiber, forage, and oilseed crops.

- **Active Farmlands or Agriculture** is farmland that consists of lands, which may or may not have been previously categorized, but are currently in active agricultural use. These lands were identified by windshield survey, and include only those lands in, or adjacent to, the I-93 primary Study Area. Included under active agricultural uses are apple orchards, truck gardens, open fields, and pasturelands.

Figure 3-5 depicts the categories of farmland as identified from NRCS soil survey maps and from windshield surveys within the I-93 Study Area.

In general, the designation of prime farmland and farmland of statewide and local importance is based on soils characteristics. The NRCS for Rockingham County and the NRCS for Hillsborough County provided a list of soil map units identified as prime farmland and farmland of statewide and local importance.¹ This information, including the soil name and associated map symbol, is shown in **Table 3-1** and **Table 3-2**. Unique farmland soils have not been classified by the NRCS in either Rockingham or Hillsborough Counties.

¹ The Derry, Londonderry, Salem, and Windham portions of I-93 Study Area are located within Rockingham County, while the City of Manchester lies within the eastern part of Hillsborough County.

Insert Figure

3-5 Farmlands

(Sheet 1 Of 2)

Insert Figure

3-5 Farmlands

(Sheet 2 Of 2)

Table 3-1
Farmland Soils
Rockingham County

Prime Farmland²

<u>Map Symbol</u>	<u>Soil Name</u>
532 A	Belgrade sil
32A	Boxford sil
62 A,B	Charlton fsl
38 A,B	Eldridge fsl
37A, B	Melrose fsl
44 A,B	Montauk fsl
66 A,B	Paxton fsl
460 B	Pennichuck channery vfsl
4	Pootatuck fsl
446 A,B	Scituate-Newfields complex fsl
68 A, B	Sutton fsl
30A	Unadilla vfsl
29 A,B	Woodbridge fsl

Farmland of Statewide Importance

<u>Map Symbol</u>	<u>Soil Name</u>
46 A,B,C	Acton fsl
532 B	Belgrade sil
32 B	Boxford sil
42 B,C	Canton gfsl
62 C	Charlton fsl
510 A,B,C	Hoosic gfsl
37 C	Melrose fsl
10 A,B,C	Merrimack fsl

² sil = silt loam; fsl = fine sandy loam; vfsl = very fine sandy loam; gfsl = gravelly fine sandy loam;
lfs = loamy fine sand; ls = loamy sand

Table 3-1
(continued)
Farmland Soils
Rockingham County

<u>Map Symbol</u>	<u>Soil Name</u>
44 C	Montauk fsl
66 C	Paxton fsl
460 C	Pennichuck channery vfsl
531 B	Scio vfsl
446 C	Scituate fsl
14 A,B	Sudbury fsl
31 B,C	Suffield sil
68 C	Sutton fsl
30 B	Unadilla vfsl
29 C	Woodbridge fsl

Farmland of Local Importance²

<u>Map Symbol</u>	<u>Soil Name</u>
43 B	Canton gfsl, very stony
63 B	Charlton fsl, very stony
313 A	Deerfield fsl
305	Lim-Pootatuck complex
45 B	Montauk fsl, very stony
67 B	Paxton fsl, very stony
533	Raynham sil
646 A	Ridgebury vfsl
656 A	Ridgebury vfsl
5	Rippowam-Pootatuck complex
33A	Scitico sil
538 A	Squamscott fsl
546 A	Walpole vfsl
26 A,B	Windsor ls

² sil = silt loam; fsl = fine sandy loam; vfsl = very fine sandy loam; gfsl = gravelly fine sandy loam;
lfs = loamy fine sand; ls = loamy sand

Table 3-2
Farmland Soils
Hillsborough County (Eastern Part)

Prime Farmland ²

<u>Map Symbol</u>	<u>Soil Name</u>
AgA	Agawam fsl
AgB	Agawam fsl
BaA	Belgrade sil
BdA, B	Bernardston Variant vfsl
MoB	Montauk fsl
NnA, B	Ninigret vfsl
Oc	Occum fsl
Om	Occum fsl, high bottom
PbB	Paxton fsl
PhB	Pennichuck fsl
PtA, B	Pittstown Variant loam
Pu	Pootatuck fsl
WoA, B	Woodbridge loam

Farmland of Statewide Importance

<u>Map Symbol</u>	<u>Soil Name</u>
BaB	Belgrade sil
BdC	Bernardston Variant vfsl
CaB, C	Canton fsl
CpB	Chatfield-Hollis-Canton fsl
MoC	Montauk fsl
PbC	Paxton fsl
PhC	Pennichuck fsl
SsA, B, C	Scituate fsl

² sil = silt loam; fsl = fine sandy loam; vfsl = very fine sandy loam; gfsil = gravelly fine sandy loam;
 lfs = loamy fine sand; ls = loamy sand

Table 3-2
(continued)
Farmland Soils
Hillsborough County (Eastern Part)

Farmland of Local Importance ²

<u>Map Symbol</u>	<u>Soil Name</u>
BeC	Bernardston Variant stony vfst
CmB, C	Canton stony fst
DeA, B	Deerfield lsf
MtB, C	Montauk stony fst
PfB, C	Paxton stony fst
StA, B	Scituate stony fst
Su	Suncook lfs
WdA, B	Windsor ls
WvB	Woodbridge stony loam

² sil = silt loam; fst = fine sandy loam; vfst = very fine sandy loam; gfst = gravelly fine sandy loam;
lfs = loamy fine sand; ls = loamy sand

3.6 Wetlands

Studies over the past few decades have found that wetlands function not only as habitat for numerous aquatic plant and animal species, but are critical for the protection of many water resources. Wetlands help to filter and purify water by trapping soil particles along with the pollutants they carry before these pollutants enter watercourses. Wetlands have an ability to absorb nutrients such as nitrogen and phosphorus, and later release these nutrients when they are less likely to degrade water quality. Wetlands act to regulate the release of stormwater by acting as temporary storage basins which can lower flood crests and reduce the destructive potential of severe storms. Wetlands stabilize the shores along rivers and lakes, as well, and further buffer the destructive forces of storms by absorbing the impact of waves. These actions alone can protect vast areas of shoreline property. Some wetlands also augment groundwater supplies by passing surface water and direct precipitation through the wetland soil into the underlying aquifers. The realization that wetlands provide certain functions and values from which the general public may benefit has led to the passage of Federal, State and local wetland laws and ordinances.

Federal protection is accorded wetlands under Section 404 of the Clean Water Act and Section 10 of the Federal Rivers and Harbors Act. The U.S. Army Corps of Engineers (Corps) is charged with the duty of overseeing and regulating activities in wetlands at the Federal level. The U.S. Environmental Protection Agency (EPA) also reviews projects that may impact wetlands and has “elevational” review authority over discharges they find unacceptable.

The State of New Hampshire regulates activities in wetlands under RSA 482-A:1 which grants regulatory authority to the NH Department of Environmental Services (NHDES), Wetlands Bureau (NHWB).

Communities in New Hampshire possess, at minimum, recommendation authority to the NHWB as to whether a permit to dredge or fill wetlands should be issued. The bulk of this recommendation responsibility is placed on the local Conservation Commissions. Individuals concerned over the protection of wetlands for certain projects, generally express their concerns through the local Commissions.

Communities also have the ability to enact their own ordinances to regulate activities in wetlands. Four of the five communities affected by the I-93 improvement have wetland protection ordinances in place. Most communities designate these areas subject to local jurisdiction as Wetland or Conservation Districts. The land area subject to a local wetland or conservation ordinance varies from community to community. The City of Manchester does not have a wetland conservation district.

3.6.1 Delineation of Wetland Resources

At present in New Hampshire, the Federal and State regulatory agencies identify and delineate wetlands based on a three parameter approach which considers plants, soils and hydrology in the interpretation of the wetland/upland boundary. These agencies identify wetlands according to the 1987 Corps of Engineers Wetland Delineation Manual (1987 Manual) that was developed and prepared by the U. S. Army Corps of Engineers (ACOE).

In 1989, a delineation and general assessment of wetlands in and around I-93 from Salem to Manchester was performed for the NHDOT. A detailed delineation of wetlands for the area within the median of I-93 was conducted, and a more cursory examination and delineation of wetlands was completed for the areas outside of, but adjacent to, the north and southbound barrels of I-93. Wetland delineation criteria were based on the 1989 Federal Manual, which is similar to the 1987 Manual but uses more conservative parameters resulting in more conservative (more wetland area) boundaries. Wetland areas were identified and delineated on 1" = 50' scale topographic maps provided by the NHDOT. Corps transect data sheets justifying placement of the wetland/upland boundary within the I-93 median area were also completed.

National Wetland Inventory (NWI) maps, prepared by the U.S. Fish and Wildlife Service, map wetlands across a region based on wetland hydrology and the preponderance of certain vegetative communities. NWI maps are available in digital format from Complex Systems at the University of New Hampshire for interpretation in ARC INFO under the Geographic Information System (GIS).

NWI maps from this computer mapping system were combined with the wetland areas delineated and identified in 1989 to produce the "general wetlands" shown on **Figure 3-6**.

During July 1998, the wetlands within the I-93 corridor were field reviewed and previous wetland delineations were revised and updated on wetland base maps. Also during July 1998, preliminary wetland delineation was extended to the first major intersections beyond the immediate interchange areas for Exits 1 through 5. The wetlands shown on **Figure 3-7** include the July 1998 revisions and extensions of preliminary wetland mapping for the Study Area. The designated prime wetlands and wetlands of local importance are sub-categories of wetland quality established by the five municipalities that comprise the Study Area.

Insert Figure

3-6 General Wetlands

(Sheet 1 of 2)

Insert Figure
3-6: General Wetlands
(Sheet 2 of 2)

Insert Figure

3-7 Field-Reviewed Wetlands And Biological Resources

(Sheet 1 Of 2)

Insert Figure

3-7 Field Reviewed Wetlands and Biological Resources

(Sheet 2 of 2)

The towns of Derry and Salem have both designated some wetlands as prime wetlands. Prime wetlands exhibit high quality wetland functions and when so designated take on a level of importance higher than wetlands not so designated. In effect, prime wetlands cannot be impacted unless the project is public in nature; mitigation will provide replacement of all functions and values, and the impacts are truly unavoidable. As such, prime wetlands are given special consideration in the analysis of alternatives for proposed development activities.

Twenty-two wetlands are designated as prime wetlands in Derry, and 25 wetlands are considered prime wetlands in Salem. Of this total of 47 prime wetlands, nine occur within approximately 1 mile of I-93. Four prime wetlands actually cross I-93; two in Salem and two in Derry. Prime wetlands in both Salem and Derry were reviewed and updated by a Professional Wetland Scientist during July 1998. The updated distribution of prime wetlands in both towns is shown on **Figure 3-7**. The locally important wetlands shown on **Figure 3-7** are under consideration for prime wetland designation in their respective municipalities.

3.6.2 Compensatory Wetland Mitigation Sites

Typically development of a program to mitigate impacts to a resource such as wetlands does not begin until impacts have been determined and evaluated. However, given the magnitude of this project and the likelihood that impacts to wetlands to some degree will be unavoidable, and in an effort to expedite the permitting process, the NHDOT has proposed, and the state and federal resource agencies have agreed, that planning and construction of wetland mitigation in advance of the I-93 project is appropriate.

In 1989, the Corps and EPA signed a memorandum of agreement (MOA) which established a policy consistent with a goal of no net loss of wetlands. The MOA provides guidelines for Corps and EPA personnel when considering mitigation requirements for wetland permit applications. With the exception of the No-Build Alternative, any alternative for I-93 will likely result in the unavoidable filling of wetlands even after the avoidance and minimization alternatives are implemented. The exact acreage of wetlands to be filled is not yet known. Anticipating that some filling may occur, and to satisfy the compensatory mitigation requirement of the MOA, the search for potential wetland mitigation sites was initiated.

Each of the five communities along the I-93 corridor were contacted in an effort to locate potential mitigation sites. Meetings and discussions were conducted with the conservation commissions, town or city planners, and other interested individuals for potential sites within each community that might satisfy advanced mitigation requirements. Preferably, potential advanced mitigation sites meet the following criteria:

- Have evidence of appropriate hydrology by either being adjacent to functioning wetlands, adjacent to streams or rivers, or influenced by a high water table.
- Be currently disturbed or degraded, whether wetland or upland.
- Be large enough to provide a minimum of 3.0 acres of mitigation area.
- Be accessible and reasonably close to I-93.
- Involve wetland creation and/or enhancement, as opposed to preservation only.
- Be publicly, versus privately, owned property.

Each potential site was subsequently field investigated by wetland mitigation specialists to discern the likelihood and cost-effectiveness of creating productive wetlands and wetlands of sufficient size. Additional factors considered during the mitigation selection process included:

- Proximity of the site to other wetlands.
- Current status of degradation of the site.
- Amount of site alteration required to create or restore wetlands.
- Quality and usefulness of the material excavated from the site.

Based on these two sets of criteria, three sites were identified which satisfy most, although not all, of these criteria. Acreage and site characteristics for these sites, identified as **L-2, L-8 and S-3**, are described below for each site. All lots are currently privately owned.

Site L-2 is located in the northeast corner of Londonderry off Auburn Road. The site actually exists as two adjoining lots, lot 32 and 36, from Map 18 of the Londonderry lot and parcel maps. Lot 32 is 215 acres in size while lot 36 is 58 acres. Both lots exist as gravel pits which show some signs of use. Both lots abut Cohas Brook, and creation of wetlands on either or both lots would provide additional wetland area to this existing wetland system. It is estimated that **Site L-2** could provide approximately 15 acres of creation and up to 260 acres of preservation.

The main characteristics that favor this site are:

1. Large size which could accommodate extensive mitigation needs.
2. Good site access (the site is approximately 1.7 miles east of I-93).
3. Reasonable likelihood for success due to the site's proximity to Cohas Brook.
4. Depending on the timing of construction, spoils excavated from the site could be used for road construction.

The primary detrimental factors concerning this site are:

1. Some portions of the sites will require considerable cuts to achieve wetland conditions and provide for stable slopes.
2. Some ledge outcrops are evident.
3. The property is privately owned.

Site L-8 is a 75-acre collection of lots located along the Londonderry/Derry border near the intersection of South Road and Gilcreast Road in Londonderry. The site borders Beaver Brook, which is a designated Conservation District (CD) pursuant to local ordinances in Londonderry. **Site L-8** is made up of three lots currently serving as gravel pits, but with the potential to become residential development. Situated on Map 7 of the Londonderry lot and parcel maps, the three lots are identified as: Lot 111 (24.4 acres), Lot 113 (38.0 acres), and Lot 114 (12.8 acres). It is estimated that the site could provide approximately 15 acres of creation and/or enhancement and approximately 60 acres of preservation.

The main characteristics that favor this site are:

1. Large site which could accommodate extensive mitigation needs.
2. Good site access; the site is located approximately 0.8 miles west of I-93.
3. High likelihood for success due to presence of Beaver Brook passing through the site.
4. Depending on the timing of construction, spoils excavated from the site could be used for road construction.
5. For the most part, the excavation depths should be relatively shallow.

The primary detrimental factor concerning this site is that it is privately owned.

Site S-3 is located in Salem off Pelham Road and consists of three lots of varying size and level of disturbance. Total acreage for these lots is 24.6 acres. Porcupine Brook, a designated Salem Prime Wetland, passes through the site. The site consists of tax maps 114 and 105, Lot 7779 (totaling 19.8 acres), and two Granite State Electric properties, Lots 10093 and 10094 (totaling 4.8 acres). The northern portion of Lot 7779 is occupied by a commercial skating rink. The portion of the lot proposed for mitigation is somewhat degraded, having served as an area for excavation and for disposal of fill materials and refuse. These portions, which were previously excavated, can easily be developed into wetlands and combined into the Porcupine Brook wetland system with minimal site grading and excavation. It is estimated that the site could provide 4 acres of creation/enhancement and 21 acres of preservation.

The main characteristics favoring this site are:

1. The size is acceptable and could accommodate a reasonable amount of mitigation in a fairly developed area.
2. The mitigation would enhance the Prime Wetlands associated with the Porcupine Brook Watershed.
3. Reasonably good access exists to the site; the site is located within 0.5 miles of I-93.
4. The site is directly located in a watershed that will be impacted from reconstruction of I-93.
5. Depending on the timing of construction, spoils excavated from the site could be used for road construction.
6. Excellent likelihood for success of the mitigation effort due to the presence of Porcupine Brook passing through the site.

The primary detrimental factors concerning this site are that it is privately owned and partly developed.

On March 2, 1999, a Public Hearing was held to consider the merits of going forward with the development of **Site L-8** and **Site S-3**. **Site L-2** was not proposed as the environmental resource agencies felt **Site L-8** and **Site S-3** hold more promise and the need for a third site is not apparent at this time. **Site L-8** and **Site S-3** were approved and the advanced mitigation project received design approval from FHWA on June 2, 1999. Designs for these two sites are underway and construction is programmed for 2000 and 2001.

3.7 Vegetation and Wildlife Habitat

New Hampshire has 318 species of terrestrial wildlife (vertebrates other than fish) species that occur as either migrants or residents. This array of wildlife species is valuable to the state. Wildlife benefits the state economically relative to tourist and recreational activities, and are invaluable in maintaining food webs, energy flows, and the ecosystem integrity.

The U.S. Fish and Wildlife Service (USFWS) is responsible for managing and protecting migratory wildlife species. Except for threatened and endangered species and their associated “critical habitats”, Federal protection of wildlife on private property is confined to regulations regarding the exploitation of species and is not extended to wildlife habitat. Both wildlife species and wildlife habitats are generally protected on Federal lands, including National Wildlife Refuges, National Parks and Monuments, and National Forests.

Each state is responsible for managing resident (non-migratory) wildlife. In New Hampshire, the NH Fish and Game Department (NHF&G) is responsible for managing and protecting resident wildlife species. NHF&G has promulgated rules (FIS Chapter 1000) for the protection and management of these species. These rules pertain almost entirely to the exploitation of the species and not to the habitats. The rules set seasons, bag limits, and legal means for the taking of game, fish, and furbearing species.

Some wildlife habitat is protected as state forests, state parks, or state-owned or state-managed wildlife management areas where additional restrictions on land use apply. In 1987 the NHF&G made public a resolution encouraging the protection of deer wintering areas (deer yards) through education, cooperative agreements, leases, easements, and acquisitions. However, no blanket legal protection was given to deer yards on privately owned lands.

NHF&G has a Non-game and Endangered Species Program, which is devoted to the conservation of non-game species and conducts research, management, and educational programs. The program has compiled natural history and distribution data on all wildlife species known to occur in the state. The NHF&G has also a cooperative agreement with the University of New Hampshire (UNH) to share data sources on the distribution of

reptiles and amphibians in southern New Hampshire. Similarly, the NHF&G has an agreement with the Audubon Society of New Hampshire (Audubon) and the New Hampshire Natural Heritage Inventory (NHNHI) to share a common database.

The Audubon has compiled a Breeding Bird Atlas of New Hampshire that documents the bird species known to nest in different areas of the state. The NHNHI, an agency within the Department of Resources and Economic Development, Office of State Planning, maintains a database, which compiles information on the distribution of 106 important habitat types in the state.

Wildlife and wildlife habitats that are considered to be important issues in land development include deer yards, high quality wetlands, waterfowl nesting habitat, vernal pools, wading bird rookeries or heronries. Also, other natural ecological communities or habitats are valued for their rarity, uniqueness of their biotic assemblages (in a regional context), or high natural biodiversity or abundance of wildlife.

3.7.1 Existing Resources

The USFWS, NHF&G, NHNHI, Audubon, Southern New Hampshire Regional Planning Commission, Rockingham Planning Commission, and the Conservation Commissions of Manchester, Londonderry, Derry, Windham, and Salem, were contacted about available information on the past, present, or probable existence of important wildlife species or wildlife habitats in the Study Area. NHF&G, NHNHI, Audubon, Southern New Hampshire Planning Commission, and the Conservation Commissions of Manchester and Salem responded.

NHF&G responded that it knew of no important wildlife habitats such as deer yards or heron rookeries within the median strip or immediately adjacent to the I-93 corridor. There are a few active beaver ponds adjacent to the highway right-of-way that provide valuable wildlife habitat for a number of species in this heavily developed area of the state. The freshwater marsh at the junction of I-293 and I-93 provides habitat for waterfowl, including birds, aquatic mammals, and amphibians. The NHF&G's response concluded with the statement that "...initial construction of I-93 fragmented wildlife habitats and travel corridors, that further widening of I-93 would further fragment these habitats and disrupt remaining corridors, and that all these impacts should be considered in the EIS."

NHNHI's response documented the occurrence of a number of state-listed rare, threatened, or endangered species in the vicinity of the Study Area (**Table 3-6**), but mentioned no other important wildlife populations or habitats.

In addition to providing information on officially state-listed threatened and endangered species, Audubon provided a list of 13 wildlife species, which may occur in the Study Area and which they believe warrant management concern (**Table 3-3**). However, none of these species are officially listed as threatened or endangered.

Table 3-3
Wildlife species that the Audubon Society of New Hampshire considers of management concern, and likely to occur in the Study Area

Common Name	Scientific Name	Habitat
Jefferson Salamander	<u>Ambystoma jeffersonianum</u>	Moist woodlands, swamps, wet meadows
Spotted Turtle	<u>Clemmys guttata</u>	Bogs, wet meadows, wooded streams, dry sandy uplands with exposed soil and sparse vegetation for nesting
Blanding's Turtle	<u>Emydoidea blandingii</u>	Shallow soft-bottomed ponds, swamps, marshes, dry sandy uplands to sparse vegetation for nesting
Eastern Hog-nosed Snake	<u>Heterodon platyrhinos</u>	Open woodlands with sandy soil
Least Bittern	<u>Ixobrychus exilis</u>	Deep emergent marshes
Red-shouldered Hawk	<u>Buteo lineatus</u>	Swampy woods, mature hardwoods
Sora	<u>Porzana carolina</u>	Deep, emergent marshes
Eastern Screech Owl	<u>Otus asio</u>	Open woodlands, shade trees
Whip-poor-will	<u>Caprimulgus vociferous</u>	Dry, open woods
Golden-winged Warbler	<u>Vermivora chrysoptera</u>	Brushy fields, thickets
Vesper Sparrow	<u>Poocetes gramineus</u>	Dry open uplands
Grasshopper Sparrow	<u>Ammodramus savannarum</u>	Dry grasslands
New England Cottontail	<u>Sylvilagus transitionalis</u>	Dense, shrubby woodlands

In their 1992 letter, Audubon also reported that three active great blue heron (Ardea herodias) rookeries occur within south central New Hampshire but indicated they are outside the project's influence. During the July 1998 field review, professional biologists noted several active great blue heron nests near the Study Area. All of these nests are located within the “Locally Important Wetlands” shown on **Figure 3-7**.

The Southern New Hampshire Planning Commission and the Salem Conservation Commission indicated they had no knowledge of important wildlife resources in the Study Area.

The Manchester Conservation Commission, as well as Federal and State resource agencies, consider the riparian wetland complex along Cohas Brook to be a particularly high value wetland.

A review of printed materials including USGS topographic maps and National Wetlands Inventory Maps, NHDOT's previous work on wetlands within the I-93 right-of-way, and windshield surveys (1992, 1993 and 1998) of the Study Area, indicate that numerous types of wildlife habitats exist within the Study Area, such as deciduous uplands, coniferous uplands, mixed uplands, forested (primarily red maple) wetlands, scrub-shrub wetlands, emergent wetlands (primarily cattail marshes), wet meadows, lakes, ponds, streams, rivers, fields/pastures and disturbed areas.

None of the wildlife habitats within the Study Area appear to be particularly pristine. Residential and commercial development is prevalent along this section of I-93, particularly in Manchester. The wildlife value of much of the existing habitat is reduced due to fragmentation (by encroaching development and I-93), frequent human disturbance such as vehicular traffic, human activity/foot traffic, noise, and pollution from highway and development runoff, and various non-point source pollution sources.

The most valuable existing habitats in the Study Area are the riparian areas along the rivers and streams (particularly Cohas Brook), lakes and ponds with accompanying buffer zones, and the larger wetlands (particularly the emergent wetlands). Also, any large contiguous blocks of forest, particularly those on public property or within wetlands where there is some measure of protection against development, are important Study Area habitats.

3.7.2 Aquatic Life

Aquatic life inhabiting lakes, ponds, and streams within the Study Area includes fish, salamanders, frogs, turtles, invertebrates, and plants. Game fish are managed by the New Hampshire Fish and Game and their harvest is regulated by State legislation. Regulations and issues applicable to other aquatic biota are discussed in the section on rare, threatened, and endangered species (**Section 3.7.4**).

Most lakes, ponds, and streams in the Study Area have typical and common warm water fish species. Golden Brook is the only stream in the Study Area stocked with trout. Only the headwaters of this stream are located in the Study Area (see **Figure 3-2**).

3.7.3 Vernal Pools

In April 1996, 19 potential vernal pools were investigated in the Study Area. These potential vernal pools were originally identified during a wetland cover type assessment conducted in 1993. Each pool was evaluated for a number of physical and biological characteristics, including approximate area dimensions, average depth, maximum depth, cover vegetation, aquatic invertebrates, amphibian observations, and number of amphibian egg masses.

Species-specific egg mass documentation was used to quantify and qualify the presence of an amphibian breeding population. In this geographic region, two amphibian species, wood frogs (*Rana sylvatica*) and spotted salamanders (*Ambystoma maculatum*), deposit egg masses that can be identified to species level in the field. These two species breed almost exclusively in vernal pools. Any other amphibians such as green frogs (*Rana clamitans*) and bullfrogs (*Rana catesbeiana*) were documented to account for wildlife use by amphibians. These latter species are not necessarily confined to vernal pools for breeding but may reside in the specific habitat or utilize it on a seasonal or transient basis. Another important criterion evaluated was the aquatic invertebrate population. Aquatic invertebrates are good indicators of water quality and duration of inundation. Fairy shrimp, caddisfly larvae, fingernail clams, and pond snails are commonly encountered in productive vernal pool habitats and indicate the seasonal hydrology and water quality are adequate to support an amphibian breeding population. A diverse population of aquatic invertebrates also provides a food source for aquatic or semi-aquatic vertebrates.

An analysis of the data collected reveals that at least seven of the 19 pools investigated during April 1996 meet the criteria typically used for vernal pool designation. These seven vernal pools, shown on **Figure 3-7**, are described as follows:

200 feet north of Southbound Station #1095-west side of I-93 within ROW

Width: 75 Feet **Length:** 110 feet **Shape:** irregular
Maximum Depth: 24 inches
Avg. Depth: 12 inches
Pool Vegetation: leather leaf, steeple bush, Rhododendron sp.
Surrounding Vegetation: scrub/shrub
Aquatic Invertebrates: mosquito larvae, midge larvae, water boatman
Adult/juvenile Amphibians observed: none
Egg Masses observed: 2 wood frog

Southbound Station #1135-west side of I-93 just outside ROW

Width: 30 Feet **Length:** 30 feet **Shape:** circular
Maximum Depth: 24 inches
Avg. Depth: 16 inches
Pool Vegetation: red maple, sedges, button bush, highbush blueberry, winterberry
Surrounding Vegetation: deciduous forested wetland
Aquatic Invertebrates: pond snail, mosquito larvae, caddisfly (fam. Limnephilidae)
Adult/juvenile Amphibians observed: 3 unidentified frogs seen jumping, one alarm call for green frog heard
Egg Masses observed: 1 wood frog

Northbound Station #1301-east side of I-93 within Northbound On-ramp loop

Width: 20 Feet **Length:** 100 feet **Shape:** irregular
Maximum Depth: 16 inches
Avg. Depth: 10 inches
Pool Vegetation: red maple, tussock sedge, Sphagnum, cinnamon fern
Surrounding Vegetation: deciduous forested wetland
Aquatic Invertebrates: caddisfly (fam. Limnephilidae)
Adult/juvenile Amphibians observed: 1 wood frog and 1 green frog observed, other unidentified frogs observed jumping
Egg Masses observed: 1 wood frog

Northbound Station #1383-east side of I-93 within ROW

Width: 145 Feet **Length:** 60 feet **Shape:** 2 basins/irregular
Maximum Depth: 30 inches
Avg. Depth: 16 inches
Pool Vegetation: button bush, highbush blueberry, winterberry
Surrounding Vegetation: deciduous forested wetland
Aquatic Invertebrates: water boatman, isopod, mosquito larvae, caddisfly (fam. Limnephilidae)
Adult/juvenile Amphibians observed: none
Egg Masses observed: 14 wood frog

Southbound Station #1378-west side of I-93 outside ROW

Width: 50 Feet **Length:** 75 feet **Shape:** circular
Maximum Depth: 48 inches plus
Avg. Depth: 30 inches
Pool Vegetation: red maple, swamp white oak, hazelnut
Surrounding Vegetation: deciduous forested wetland
Aquatic Invertebrates: water boatman, caddisfly (fam. Limnephilidae)
Adult/juvenile Amphibians observed: none
Egg Masses observed: 10 wood frog

Northbound Station #1398-east side of I-93 outside ROW

Width: 50 Feet **Length:** 100 feet **Shape:** irregular
Maximum Depth: 24 inches
Avg. Depth: 8 inches
Pool Vegetation: elm, winterberry, red maple, highbush blueberry, sedge, wildberry, coontail, woodwardia fern
Surrounding Vegetation: deciduous forested wetland
Aquatic Invertebrates: caddisfly (fam. Limnephilidae and Phyganeidae)
Adult/juvenile Amphibians observed: none
Egg Masses observed: 13 spotted salamander, 11 wood frog

Northbound Station #1678-east side of I-93 outside ROW

Width: 90 Feet **Length:** 150 feet **Shape:** irregular
Maximum Depth: 36 inches
Avg. Depth: 24 inches
Pool Vegetation: red maple, buttonbush, highbush blueberry, wildcelery, broad leaved meadowsweet, Sphagnum
Surrounding Vegetation: deciduous forested wetland
Aquatic Invertebrates: caddisfly (fam. Limnephilidae and Phyganeidae), fair shrimp
Adult/juvenile Amphibians observed: none
Egg Masses observed: 50 spotted salamander, 3 wood frog

3.7.4 Rare, Threatened, and Endangered Species

State Regulatory Protection

In the State of New Hampshire, the Endangered Species Conservation Act (RSA 212-A) delegates authority and responsibility for the listing and protection of threatened and endangered species of wildlife to the New Hampshire Department of Fish and Game (NHF&G). NHF&G has in turn promulgated the rules for the protection of these species in Fish and Game Rules, Conservation of Endangered Species. These regulations restrict the killing or taking, and transportation of listed species, but do not describe or protect the species' habitats. Species eligible for listing under these rules include invertebrates and vertebrate species of fish and wildlife (plants are not included). Protected animal species are placed in one of two categories, threatened or endangered, depending on their rarity.

NHF&G manages threatened and endangered species cooperatively with the Audubon Society and the NHNHI. The NHNHI has compiled information on the distribution and abundance of these species from the literature, from files of area scientists, and from various field surveys, into computerized data banks. These data banks provide information on the present, past, or probable existence of such species for improved land use planning and environmental impact assessment.

The New Hampshire Native Plant Protection Act RSA 217, enacted by the State Legislature in 1987, established the authority for the state to develop a list of rare plant species. The NHNHI was empowered with this authority and developed the list in their Administrative Rules PART Res-IV 306 PLANT LISTING. Plants deemed as rare in the State and in need of protection were listed as either endangered, threatened, or special concern plant species in descending order of rarity.

Unlike federally listed species, plant or wildlife species need only be rare within the State of New Hampshire to be state-listed, not rare over the entire range of the species.

Therefore, many state-listed species are rare because New Hampshire is at the edge of their range, or because there is a limited amount of habitat for the species within the state. Legal protection is also much less stringent in state statutes. Besides the prohibitions on the taking or killing of state-listed wildlife species, protection of state listed plants or animals is largely restricted to recommendations by the aforementioned state agencies for the approval or disapproval of projects which might impact the environment. All projects initiated or funded by the state, or applying for such state permits as Wetlands Alteration Permits, or Site Specific Permits, are forwarded to NHF&G and NHNHI, which have the opportunity to recommend approval or denial.

Federal Regulatory Protection

The Endangered Species Act of 1973 (“ESA”) (P.L. 93-205), as amended in 1973 and 1978, recognizes the need, and provides the means to protect rare plants, invertebrates and vertebrate species of fish and wildlife, and provides for the protection and/or acquisition of critical habitats and the management of endangered species. Per the 1978 Amendments to the ESA, separate (geographically or genetically isolated) but rare populations of fish and wildlife (but not plants or invertebrates) may be protected as well as entire species. Listed species are categorized as either endangered species which are in danger of extinction throughout all or a substantial portion of its ranges, or threatened species which are likely to become endangered throughout all or a substantial portion of its range.

Section 7 of the ESA dictates that all federal agencies must consult the U.S. Department of the Interior (USDI) to ensure that actions taken under federal funding, federal assistance, or federal permits (e.g. Section 404 Wetland Fill Permits) do not jeopardize the existence of threatened or endangered species. Jurisdiction is given to the USDI to recommend changes to the project to avoid such jeopardy (including impacts to the habitat as well as to the plants or animals themselves).

Rare, Threatened and Endangered Species

Invertebrate and vertebrate species of wildlife, which are officially listed by the State (state-listed) per the Endangered Species Conservation Act (RSA 212-A) and its administrative rules as threatened or endangered, include 34 species.

Plant species officially listed by the State (state-listed) as endangered, threatened, or special concern species per the New Hampshire Native Plant Protection Act (1987 RSA 217) and its Administrative Rules (Res-N 306) include 142 species that are endangered, 147 that are threatened, and 11 that are special concern species.

The list of plant and wildlife species considered to be threatened or endangered, by the United States Government (federal-listed) per the Endangered Species Act of 1973 and associated Administrative Rules of the U.S. Fish and Wildlife Service (50 CFR 17.11 & 17.12) that have occurred or have a high probability of occurring in New Hampshire are presented in **Table 3-4** and **Table 3-5**.

Table 3-4
Federally-listed threatened and endangered wildlife
species that may occur in New Hampshire*

Common Name	Scientific Name	Federal Status	State Statutes
Peregrine Falcon	<u>Falco peregrinus</u>	Endangered	Endangered
Bald Eagle	<u>Haliaeetus leucophalus</u>	Endangered	Endangered
Roseate Tern	<u>Sterna dougallii</u>	Endangered	Threatened
Piping Plover	<u>Charadrius melodus</u>	Endangered	Endangered
Shortnose Sturgeon	<u>Acipenser brevirostrum</u>	Endangered	Endangered

* Data adapted from NHF&G List of Endangered and Threatened and Species in New Hampshire (Effective 6/2/87).

Table 3-5
Federally listed, threatened, and endangered plant species that may occur in New Hampshire*

Common Name	Scientific Name	Federal Status	State Statutes
Robbin's Cinquefoil	<u>Potentilla robbinsiana</u>	Endangered	Endangered
Jesup's Milkvetch	<u>Astragalus robbinsiana</u>	Endangered	Endangered
Long's Bitter-cress	<u>Cardamine longii</u>	Threatened	Threatened
Variable Sedge	<u>Carex polymorpha</u>	Threatened	Threatened
Boot' Rattlesnake-root	<u>Prenanthes boottii</u>	Threatened	Threatened

* Data from NHF&G List of Endangered and Threatened Species in New Hampshire (effective 6/2/87).

To determine the past, present, or probable existence of any of these species or their designated habitats within the Study Area, letters were forwarded to a number of public and private conservation agencies requesting any information they might have on the subject. The following organizations were contacted:

- U.S. Fish and Wildlife Service
- New Hampshire Fish and Game Department
- New Hampshire Natural Heritage Inventory
- Audubon Society of New Hampshire
- Rockingham Planning Commission
- Southern New Hampshire Regional Planning Commission
- Manchester Conservation Commission
- Londonderry Conservation Commission
- Derry Conservation Commission
- Windham Conservation Commission
- Salem Conservation Commission

The USFWS, NHF&G, the NHNHI, the Audubon Society of New Hampshire, the Southern New Hampshire Regional Planning Commission and the Salem and Manchester Conservation Commissions responded.

The NHF&G concluded from a review of the files, that no state threatened or endangered wildlife species are known to occur in the Study Area that would be impacted by a build alternative for the project.

The NHNHI responded that its data banks contained specific or general (location) reports of 26 occurrences within the vicinity of I-93 between Salem and Manchester. These occurrences included one rare reptile species and 25 rare plants, of which 16 are state-threatened and 8 are state endangered. No federally-protected species were noted in the Study Area. Information on the documented occurrences of listed-species in the Study Area is provided in **Table 3-6**.

Table 3-6
Documented occurrences of state-listed threatened and endangered plant and animal species in the vicinity of I-93 from Salem to Manchester according to New Hampshire Natural Heritage Inventory (NHNHI) Files.

Scientific Name	Common Name	Ranks	Status	Location	Last Observed
<u>Animal Species</u>					
<u>Heterodon platyrhinos</u>	Eastern hog-nose snake	S2 G5	ST	Manchester Bricket Rd/I-93	1977
<u>Plant Species</u>					
<u>Arethusa bulbosa</u>	Arethusa	S1 G4	SE	Windham Depot	1909
<u>Aureolaria virginica</u>	Downy false foxglove	S2 G5	ST	Windham Center	1906
<u>Triosteum aurantiacum</u>	Orange horse-gentian	S1 G5	SE	Windham Center	1897
<u>Lupinus perennis</u>	Wild lupine	S1 G5	ST	Between Exits 1 & 2 on west side of I-93	1985
<u>Rhododendron viscosum</u>	Swamp azalea	S2 G5	ST	Salem: Behinolk St.	1980
<u>Viola pedata</u> var <u>lineariloba</u>	Bird's foot violet	S2 G5	ST	Manchester	1948
<u>Equisetum palustre</u>	Marsh horsetail	S1 G5	ST	Manchester	1899
<u>Asclepias amplexicaulus</u>	Blunt-leaved milkweed	S2 G5	ST	Windham	1888
<u>Polygonum tenue</u>	Slender knotweed	S1 G5	ST	Windham	1890
<u>Hypoxis hirsuta</u>	Hairy stargrass	S2 G5	ST	Windham	1878
<u>Viola pedata</u> var <u>lineariloba</u>	Bird's foot violet	S2 G5	ST	Windham	1893
<u>Lupinus perennis</u>	Wild Lupine	S1 G5	ST	Windham	1951
<u>Carex exilis</u>	Meagre sedge	S1 G5	ST	Windham	1897
<u>Rhododendron viscosum</u>	Swamp azalea	S2 G5	ST	Windham	1876
<u>Gentiana crinata</u>	Fringed gentian	S2 G4	ST	Windham	1885

**Table 3-6
(continued)**

Documented occurrences of state-listed threatened and endangered plant and animal species in the vicinity of I-93 from Salem to Manchester according to New Hampshire Natural Heritage Inventory (NHNHI) Files.

Scientific Name	Common Name	Ranks	Status	Location	Last Observed
<u>Eupatorium sessilifolium</u>	Upland boneset	S1 G5	SE	Windham	1899
<u>Aster patens</u> var <u>patens</u>	Skydrop aster	S2G5T5	ST	Windham	no date
<u>Eleocharis tuberculosa</u>	Tuberclcd spike-rush	S2 G5	SE	Windham	1897
<u>Sericocarpus linifolius</u>	White-topped aster	S1 G5	ST	Windham	1886
<u>Desmodium rigidum</u>	Stiff tick-trefoil	SH G5	SE	Windham	1892
<u>Asclepias purpurascens</u>	Purple milkweed	SHG4G5	ST	Windham	1892
<u>Camptosorus rhizophyllus</u>	Walking-fern spleenwort	S1 G5	SE	Windham	1894
<u>Arethusa bulbosa</u>	Arethusa	S1 G4	SE	Windham	1876
<u>Hypoxis hirsuta</u>	Hairy stargrass	S2 G5	ST	Londonderry	1947
<u>Viola pedata</u> var <u>lineariloba</u>	Bird's foot violet	S2 G5	ST	Londonderry	1858

Ranks:

S1 = Critically imperiled in state because of extreme rarity

S2 = Imperiled in state because of rarity (6-20 occurrences)

G4 = Apparently secure globally but may be rare in parts of range

G5 = Demonstrably secure globally but may be rare in parts of range

Status:

SE = State Endangered

ST = State Threatened

SH = Historical Occurrence.

Note: The NHNHI cautioned that these are the results of a data bank check for reported occurrences; they are not field survey results.

In addition to the previous NHHI list of documented occurrences of state-listed species in the Study Area, the Audubon Society of New Hampshire (Audubon) expressed concern about the following wildlife species that they characterized as having a “high potential of occurrence” in the Study Area:

- The Pied-billed Grebe (Podilymbus podiceps), is a small diving bird, that typically breeds/nests in emergent/open water wetlands of at least 50 acres, and uses lakes, ponds, and rivers. Substantial amounts of emergent wetlands and surface waters exist within and near the Study Area and may provide habitat for this species. However, NHHI has not documented this species in the Study Area.
- The state-listed endangered Upland Sandpiper (Bartramia longicauda) has had a nesting population as recently as 1984 at the Manchester Airport. This shorebird nests in wide open habitat such as airports, pastures, and hayfields. However, NHHI has not documented this species in the Study Area.
- The Merrimack River within Manchester and Londonderry constitutes a major portion of New Hampshire's primary bald eagle (Haliaeetus leucocephalus) wintering area; however, Audubon expressed the opinion that the project would have no impact on bald eagles or their habitat.
- The Sedge Wren (Cistithorus platensis), a small state-listed endangered species, uses emergent marshes and sedge meadows during breeding and migrating seasons. However, NHHI has not documented this species in the Study Area.
- Henslow's Sparrow (Ammodramus henslowii) is a small, state-listed endangered species that breeds in wet meadows and moist, weedy fields. However, NHHI has not documented this species in the Study Area.
- According to Audubon, the Brook Floater, a state-listed endangered species of mollusk is known to occur in the Merrimack River in Manchester. However, Audubon assumed the project would have no impact on the species unless it precipitated a siltation event in the Merrimack River.
- The Common Loon (Gavia immer), a state-listed threatened species, is known to nest at Massabesic Lake in Manchester. However, Audubon felt it unlikely that the project would impact this species.
- According to Audubon, the Northern Harrier (Circus cyaneus), a large, state-listed threatened species of hawk has been reported from Derry, Londonderry, and Manchester in the past decade. However, the Society felt it unlikely that the project could impact this species which forages over large open fields, pastures, and marshes.

- The Osprey (Pandion haliaetus), a large piscivorous raptor (state-listed threatened) is known to forage in the Merrimack River, in ponds of all sizes, and in wetlands with open water in the area during migration. However, Audubon felt it unlikely that the project would impact the species.
- Audubon indicated that downtown Manchester supports one of the state's largest populations of Common Night Hawks (Chordeiles minor), a state-listed threatened species which commonly nests on flat graveled roof tops. Again Audubon felt the project would have no impact on this species.
- The Purple Martin (Progne subis), a state-listed threatened bird species, typically nests in man-made birdhouses adjacent to extensive open fields and water. Audubon related that sightings were made in Manchester in 1982, but that the project is unlikely to affect this species.
- The Cooper's Hawk (Accipiter cooperii) is a small bird-eating hawk that is state-listed as threatened. Sightings have been made of this bird in Manchester (in the last 10 years) and Windham (in the 1970's). The Cooper's Hawk nests in deciduous and mixed forests. These habitats are found within the Study Area. However, NHHI has not documented this species in the Study Area.

The Southern New Hampshire Planning Commission responded to letter requests but offered no information on the presence/absence of rare, threatened or endangered species in the Study Area.

The Manchester Conservation Commission stated that it has no information regarding the presence of rare, threatened or endangered species in the Study Area. Mr. Ross Moldoff, Town Planner for Salem, responded by telephone for the Conservation Commission and indicated that they have no knowledge of the existence or distribution of listed species in the Study Area.

3.8 Air Quality

The project comprises an 18-mile section of I- 93 from the New Hampshire/Massachusetts State Line in the town of Salem northerly to the junction of I-93 with I-293 in the City of Manchester. This section of I-93 passes through five towns or cities (Salem, Windham, Derry, Londonderry, and Manchester) and includes five interchanges, one northbound rest area, one northbound and one southbound weigh station, and a highway maintenance yard.

The State of New Hampshire Department of Transportation (NHDOT) proposes to improve this section of I-93 in order to increase capacity and improve traffic flow, as well as reduce safety problems associated with this section of roadway.

3.8.1 Introduction

For traffic-related impacts, the pollutants of interest are carbon monoxide and ozone. The primary concerns will be:

1. whether the proposed roadway alternatives will create or exacerbate violations of carbon monoxide (CO) standards, and
2. whether the proposed action will increase or decrease the regional emissions of ozone precursors [primarily volatile organic compounds (VOCs) and nitrogen oxides (NO_x)].

The Study Area has several non-attainment designations based upon the fact that the 1-hour ozone standard has been revoked for the whole Study Area. However, the EPA published a proposed rule on 10/25/99 (64 FR 57424) which is expected to reinstate the 1-hour standard and revert the study area back to its previous non-attainment status. The previous ozone non-attainment status for the City of Manchester is “Marginal”. The previous ozone non-attainment status for Salem, Windham, Derry, and Londonderry, which are part of the Southern NH Ozone Non-Attainment Area, is “Serious”. The City of Manchester is also currently designated non-attainment for CO. It should be noted that New Hampshire has requested that EPA redesignate the City to attainment.

The air quality study will include a microscale modeling analysis that will predict CO levels at critical receptor locations along the project corridor. The microscale analysis will be conducted according to EPA guidelines. The air quality study will also describe the contribution of the project to the regional emissions of CO and the ozone precursors. The regional emissions will be addressed in the mesoscale portion of the air quality analysis.

3.8.2 Mobile Source Analysis

The mobile source analysis will consider both the Build and No-Build alternatives for the project's opening (**2005**) and design year (**2020**). The existing conditions will be updated to reflect the new "baseline" year in the Traffic Analysis section.

3.8.2.1 Emissions: Mesoscale Analysis

A total burden analysis, including this project, was completed for inclusion in the "Fiscal Year 1999 Conformity Determination." The Conformity document is currently being updated and the regional impacts of this project will once again be included. Therefore, a regional analysis outside of that completed for the next conformity determination is not necessary.

3.8.2.2 *Microscale Analysis*

Dispersion Model

The microscale analysis will be conducted utilizing the CAL3QHC Version 2 model for free flow and intersection roadway links. CAL3QHC is recommended by the EPA and is required by EPA Region I for the air quality analysis of major congested intersections. The effect and extent of vehicle queuing on CO levels at each intersection will be determined by CAL3QHC at the intersection of analysis by evaluating the following input; the MOBILE idle emission rates, exhaust emission factors, total signal cycle time, effective red time, volumes, roadway geometry, and capacity of intersection. The data will be used to develop queuing links at approaches of each analysis site.

Analysis Sites

The analysis sites will be chosen according to EPA criteria. Intersections will be ranked according to traffic volumes and levels of service (LOS) (See EPA's "Guidelines for Modeling Carbon Monoxide From Roadway Intersections"). These sites will include locations that may potentially be affected by critical roadway links and intersections. They will be points of potential exceedances of air quality standards, locations adjacent to sensitive land uses, and other representative locations throughout the Study Area. These sites will be determined in coordination with the traffic analysis and land use information. It is anticipated that seven (7) air quality analysis sites will be selected. Up to six (6) of these sites will either be interchanges or intersections of two or more congested roadways directly adjacent to I-93. The seventh site will probably be along the right-of-way of the affected portions of I-93 itself. The final selection of these sites will be made in consultation with FHWA, NHDOT, and the cognizant air quality review agencies.

Receptor locations will be assigned to each analysis site. The number and location will be determined on an individual basis for each site. There will be approximately twenty (20) specific air quality receptor locations at each analysis site to ensure that the worst case location is identified. The receptor heights will be 1.8 meters (6 ft.) above grade.

Emission Factors

The vehicle emission factors that will be used in the microscale analysis will be obtained using the latest version of EPA's MOBILE computer model. MOBILE calculates CO, NO_x, and VOCs using emission factors for motor vehicles as input. The emission factors will be adjusted to reflect New Hampshire-specific conditions, such as temperatures representative of the pollutant season and appropriate fuel programs.

Worst Case Meteorological Conditions

The worst case meteorological conditions, including wind speed, stability class, ambient temperature, and persistence factor will be selected and utilized for the microscale analysis peak one-hour period as follows:

- Wind Speed: 3.3 feet/second (1 meter/second)
- Wind Direction: Worst Case wind angle search
- Wind Angles: 10 degrees increments from 0 to 360 degrees
- Stability class: D
- Temperature: 30 degrees Fahrenheit
- Mixing Height: 3,280 feet (1,000 meters)

CO Background Values

In determining the total impact of the project, it is necessary to include consideration of the background CO levels for the area. The background level is the component of the total concentrations not accounted for through the individual roadway links. Applicable background concentrations are added to the modeling results to obtain total pollutant concentrations at each receptor site for each analysis year. The NHDES will be contacted to provide estimated background CO levels for existing and future years.

3.8.3 Model Predictions

The air quality study will evaluate the existing conditions, the estimated year of project opening, and the design year. The CO concentrations for the future years will include No-Build and Build alternatives. The maximum one and eight hour concentrations will be estimated at each analysis site. The CO results will be compared with both the National and State Ambient Air Quality Standards.

An assessment of the consistency of each alternative with the strategies contained in applicable parts of the State Implementation Plan (SIP) for the area will be prepared. This analysis will include a discussion of possible traffic control measures and physical improvements necessary to attain CO standards as specified in the SIP. An assessment of this project, with respect to the Transportation Conformity requirements of the 1990 Clean Air Act Amendments, will also be conducted.

A qualitative analysis will be performed, if necessary, to identify and discuss the potential effectiveness of mitigation measures designed to minimize any substantial adverse impact of each of the alternatives.

3.9 Noise

The noise analysis is designed to indicate the magnitude and extent to which noise-sensitive receptors would experience changes in noise due to improvements to I-93 between the Massachusetts state line in Salem and the I-93/I-293/NH101 split in Manchester. The noise analysis will follow the NHDOT's "*Policy and Procedural Guidelines for the Assessment and Abatement of Highway Traffic Noise for Type I Highway Projects*" dated July 1996.

The noise analysis will evaluate the highest noise levels in the Study Area based on a review of hourly traffic data and noise monitoring data. The highest noise levels typically occur during the evening peak hour traffic commuting period. A noise monitoring program measured existing peak hour sound levels at up to six receptor locations within the Study Area to help establish existing sound levels and to calibrate the noise model to this specific roadway.

Receptor locations sensitive to highway traffic noise include, but are not limited to, residences, churches, schools, libraries, meeting halls, parks, and natural areas. Commercial businesses may also be sensitive to noise, although to a lesser degree in most instances. The project is a mix of sensitive land uses.

The Federal Highway Administration's (FHWA) noise analysis computer program model, Traffic Noise Model (TNM), will be used to predict noise levels at all receptor locations affected by any of the project alternatives, including the No-Build alternative. Noise impacts will be determined in accordance with the criteria outlined in 23CFR772.

The noise modeling input data will include peak hour traffic volumes, vehicle mix, vehicle speeds, and roadway and receptor geometry. The existing and future (design year) sound level predictions will be based on the highest noise period. The noise analysis will calculate the sound levels at each receptor location and compare the results to the NHDOT and FHWA noise impact criteria. Where noise impacts are identified, mitigation measures will be evaluated to determine if they are reasonable, feasible, and likely to be included in the project.

Traffic noise impacts occur when predicted noise levels approach (defined within 1 dBA) or exceed the FHWA Noise Abatement Criteria (67 dBA for residences; 72 dBA for businesses) or when predicted noise levels substantially exceed existing noise levels. In New Hampshire, substantially exceeding the existing noise levels means an increase of 15dBA or more. It is generally observed that a 0-5 dBA increase represents a slight or no adverse impact; a 6-15 dBA increase represents a moderate adverse impact; and a greater than 16 dBA increase reflects an adverse impact that warrants further review and possibly mitigation measures. Conversely, noise level reductions would represent beneficial effects. Abatement measures will be considered where impacts are identified.

3.10 Demographics

The five Study Area communities fall within two different counties and three different labor market/metropolitan statistical areas. Derry, Londonderry, Salem, and Windham are located in Rockingham County, and Manchester is located in Hillsborough County. Derry, Salem, and Windham are part of the NH portion of the Lawrence, MA Primary Metropolitan Statistical Area (PMSA)²; Londonderry is part of the Nashua Primary Metropolitan Statistical Area (PMSA)³; Manchester is part of the Manchester Primary Metropolitan Statistical Area (PMSA)⁴. Manchester, Derry and Londonderry are part of the Southern New Hampshire Regional Planning Commission, and Windham and Salem are part of Rockingham Regional Planning Commission. Population, housing, employment, and wage information for these areas is presented and analyzed below.

3.10.1 Population

Derry, Londonderry, and Windham each experienced substantial population growth over the 1970's and 1980's. Average annual growth in these three communities during these periods ranged from 4 to 15 percent. The populations of Londonderry and Windham

2 The other communities in the NH portion of the Lawrence, MA PMSA are Atkinson, Brentwood, Danville, East Kingston, Hampstead, Kingston, Newton, Plaistow, Sandown and Seabrook.

3 The other communities in the Nashua PMSA are Amherst, Brookline, Hollis, Hudson, Litchfield, Merrimack, Milford, Mont Vernon, Nashua and Wilton.

4 the other communities in the Manchester MSA are Allenstown, Auburn, Bedford, Candia, Goffstown and Hookset.

roughly tripled between 1970 and 1990, with Londonderry growing from approximately 5,300 to 19,800 people and Windham increasing from 3,000 to 9,000 people. Derry's population more than doubled over the same period, increasing from approximately 11,700 to 29,600. Between 1990 and 1997 growth slowed for all five communities, with an average annual growth rate slightly over 1% (see **Table 3-7 Population**).

Average annual population increases during the 1970's and 1980's in these three communities were substantially higher than for Rockingham County (nearly 3 percent) or the state as a whole (2 percent). Derry and Londonderry also experienced the greatest absolute growth of the five Study Area communities, increasing by 17,900 and 14,400 people respectively between 1970 and 1990. Between 1990 and 1997, growth was slower, with absolute growth of approximately 2,400 and 1,700 respectively.

In Salem, population growth was more moderate during the 1970's (nearly 2 percent average annual change) and 1980's (less than 1 percent), falling below average annual growth rate for Rockingham County in both decades. The 1990's have seen Salem's growth rate rebound to nearly 1 percent, in keeping with the rate for Rockingham County's as a whole. Manchester also experienced relatively slow growth during this period, with average annual percent growth of approximately ½ percent during the 1970's and less than 1 percent during the 1980's. This was substantially below average annual growth rates in Hillsborough County (2.4 percent during the 1970's and 2.1 percent during the 1980's) and the state as a whole (2.5 percent during the 1970's and 2.0 percent during the 1980's). Manchester's average annual growth rate has remained low during the 1990's, at less than 1%, though it is in less variance with Hillsborough County (at 1%) and the state as a whole (less than 1% than in earlier decades) (see **Table 3-7 Population**).

**Table 3-7
Population**

<u>Comments</u>	<u>1970</u>	<u>1980</u>	<u>1990</u>	<u>1997 est.</u>	<u>Absolute Change 1970-1980</u>	<u>Average Annual Change 1970—1980</u>	<u>Absolute Change 1980-1990</u>	<u>Average Annual Change 1980-1990</u>	<u>Absolute Change 1990-1997</u>	<u>Average Annual Change 1990-1997</u>
Salem	20,142	24,124	25,746	27,378	3,982	1.98%	1,622	0.67%	1,632	0.91%
Windham	3,008	5,664	9,000	9,844	2,656	8.83%	3,336	5.89%	844	1.34%
Derry	11,712	18,875	29,603	32,019	7,163	6.12%	10,728	5.68%	2,416	1.17%
Londonderry	5,346	13,598	19,781	21,529	8,252	15.44%	6,183	4.55%	1,748	1.26%
Manchester	87,754	90,936	99,332	103,330	3,182	0.36%	8,396	0.92%	3,998	0.57%
Rockingham County	138,950	190,345	245,845	261,634	51,395	3.70%	55,500	2.92%	15,789	0.92%
Hillsborough County	223,941	276,608	335,838	359,147	52,667	2.35%	59,230	2.14%	23,309	0.99%
New Hampshire	737,578	920,475	1,109,117	1,173,000	182,897	2.48%	188,642	2.05%	63,883	0.82%

Source: 1970 U.S. Census
1980 U.S. Census
1997 Population Estimates of New Hampshire Cities and Towns, NH Office of State Planning, August 1998

3.10.2 Housing

Table 3-8 depicts the 1990 number of housing units in each of the five Study Area communities, as well as Rockingham County, Hillsborough County, and the state as a whole. Manchester has the most housing units with 45,316 units, followed by Derry with 12,737 units, Salem with 10,672 units, Londonderry with 7,411 units and Windham with 3,708 units.

The most substantial average annual growth in housing units over the 1980-1990 decade was experienced by Windham, (9 percent), Derry (7 percent), and Londonderry (5 percent). Generally these figures were higher than average annual percent growth in the County (5 percent) or the state (4.5 percent) over the same period. From 1990-1997, however, these average annual growth rates dropped, to a rate of about 1.5%.

Table 3-9 depicts housing units by type for each of the Study Area communities. While each of the five communities offers a range of housing types, the 1996 housing mix in Manchester and Derry is characterized by relatively large percentages of multi-family units, 63 percent and 46 percent respectively. At the other end of the spectrum, Windham is comprised predominantly of single family homes (91 percent) (see **Table 3-8. Total Housing Units** and **Table 3-9. Housing Units by Type.**)

3.10.3 Employment

The City of Manchester is a major regional employment center, providing approximately 55,850 jobs to area residents as of 1990. Salem also has a substantial economic base, with 15,400 jobs. Derry and Londonderry, with smaller employment bases, provided approximately 6,400 jobs and 5,600 jobs in 1990. Windham has the smallest employment base of the five Study Area communities, with 1,300 jobs (see **Table 3-10. 1990 Average Annual Employment.**)

The principal economic sectors within Rockingham County and Hillsborough County include trade, services, and manufacturing. In 1990, trade accounted for 32 percent of employment in Rockingham County, while services accounted for 25 percent, and manufacturing for 17 percent. By 1996, trade grew to 34 percent and services to 29 percent, while manufacturing dropped to 15% of the total. In Hillsborough County manufacturing employment played a larger role than in Rockingham County, with 27 percent of employment, followed by services and trade each with 25 percent. By 1996, however, dominance had reversed with service jobs representing 29 percent, trade at 24 percent and manufacturing at 23 percent.

Table 3-8
Total Housing Units

	All Housing Units			Average Annual Change	
<u>Comments</u>	<u>1980</u>	<u>1990</u>	<u>1996 est</u>	<u>1980-1990</u>	<u>1990-1996</u>
Salem	8,848	9,897	10,672	1.8%	1.3%
Windham	1,726	3,327	3,708	9.3%	1.2%
Derry	7,280	11,869	12,737	6.8%	1.2%
Londonderry	4,584	6,739	7,411	4.7%	1.7%
Manchester	35,869	44,361	45,316	2.4%	0.4%
Rockingham County	76,115	100,479	109,110	4.8%	1.4%
Hillsborough County	101,208	135,622	144,131	3.6%	1.1%
New Hampshire	386,381	502,247	534,111	3.75%	1.9%

Source: 1980 U.S. Census
1990 U.S. Census and 1996 estimates as published in Current Estimates and Trends in New Hampshire's Housing Supply, Update: 1996, NH Office of State Planning, 1997, and Corrections to Current Estimates and Trends in New Hampshire's Housing Supply, Update: 1996, NH Office of State Planning, 1998

Table 3-9
Housing Units-By Type

	All Housing Total		Single Family			Multi-Family			Mobile Homes		
Community	1990 Number	1996 Number	1990 Number	1996 Number	1996 %	1990 Number	1996 Number	1996 %	1990 Number	1996 Number	1996 %
Salem	9,897	10,672	6,710	7,300	68%	2,321	2,506	23%	866	866	8%
Windham	3,327	3,708	3,031	3,384	91%	284	312	8%	12	12	-
Derry	11,869	12,737	5,549	6,355	50%	5,747	5,807	46%	573	575	5%
Londonderry	6,739	7,411	4,395	4,991	67%	1,754	1,828	25%	590	592	8%
Manchester	44,361	45,316	15,306	16,318	36%	28,569	28,507	63%	486	491	1%
Rockingham County	100,479	109,110	61,121	68,406	63%	30,508	31,556	29%	8,850	9,148	8%
Hillsborough County	135,622	144,131	71,819	79,198	55%	59,104	60,011	42%	4,699	4,922	3%
New Hampshire	503,541	534,111	297,448	322,567	60%	162,998	166,523	31%	41,801	45,021	8%

Source: 1990 U.S. Census and NH Office of State Planning estimates as published in “Current Estimates and Trends in New Hampshire’s Housing Supply, Update: 1996”, NH Office of State Planning, December 1997; Corrected February 1998

Table 3-10
1990 Average Annual Employment

	Salem		Windham		Derry		Londonderry		Manchester	
Sector	Number	%	Number	%	Number	%	Number	%	Number	%
Manufacturing	4,025	26%	174	13%	1,456	23%	1,035	19%	9,510	17%
Construction & Mining	395	3%	234	18%	360	6%	509	9%	1,476	3%
Trans., Comm. & Utilities	473	3%	31	2%	191	3%	481	9%	2,878	5%
Trade	5,849	38%	420	32%	1,550	24%	1,740	31%	14,769	26%
Finance, Insurance & Real Estate	457	3%	74	6%	250	4%	191	3%	6,000	11%
Government	645	4%	-		644	10%	-		3,672	7%
Service & Other	3,556	23%	388	29%	1,926	30%	1,604	29%	17,545	31%
TOTALS	15,400		1321		6,377		5,560		55,850	

	Rockingham County		Hillsborough County		Manchester PMSA		NH Portion Lawrence-Haverhill PMSA		Nashua PMSA	
Sector	Number	%	Number	%	Number	%	Number	%	Number	%
Manufacturing	15,430	17%	43,543	27%	11,104	15%	7,347	21%	30,930	37%
Construction & Mining	5,094	6%	6,036	4%	3,338	5%	1,986	6%	2,968	4%
Trans., Comm. & Utilities	4,143	5%	6,729	4%	3,566	5%	1,868	5%	2,233	3%
Trade	29,584	32%	40,344	25%	20,237	28%	12,369	35%	20,768	25%
Finance, Insurance & Real Estate	5,820	6%	11,372	7%	8,040	11%	1,134	3%	3,235	4%
Government	8,343	9%	11,296	7%	5,089	7%	2,986	8%	5,941	7%
Service & Other	22,949	25%	40,682	25%	21,803	30%	7,772	22%	18,523	22%
TOTALS	91,363		160,002		73,177		35,462		84,598	

Source: 1990 Profile, Employment and Wage Data, NH Employment Security, Economic and Labor Market Information Bureau, 1992
1990 County Profile, Employment and Wage Data, NH Employment Security, Economic and Labor Market Information Bureau, 1992

Similarly, manufacturing, services, and trade are the most important economic sectors within the Manchester PMSA, Nashua PMSA, and NH portion of the Lawrence, MA PMSA. Services are the primary industry in the Manchester PMSA with 32 percent of 1996 employment, up from 30 percent. In the NH portion of the Lawrence-Haverhill, MA PMSA, trade is the principal industry, with 37 percent of employment in 1996, up from 35 percent in 1990. In the Nashua PMSA, manufacturing is the predominant industry, with 31 percent of employment in 1996, down from 37 percent in 1990 (see **Table 3-11. 1990 and 1996 Average Annual Employment**).

In 1990, the trade, services, and manufacturing sectors constitute the primary economic sectors within the five individual I-93 Study Area communities, with the exception of Windham, where construction and mining plays a stronger economic role (18%) than manufacturing (13%). In Derry and Manchester, services and trade are the most important employment sectors. The services and trade sectors account for 30 percent and 24 percent respectively of employment in Derry, and 31 percent and 26 percent, respectively, of employment in Manchester. In Londonderry and Windham, trade and services played the strongest economic roles. Trade accounted for 31 percent of employment in Londonderry and 32 percent of employment in Windham, while services comprised 29 percent of employment in both Londonderry and Windham. In Salem, trade was the strongest sector, with 38 percent of employment, followed by manufacturing with 26 percent (see **Table 3-12. 1990 Average Annual Employment**).

While Manchester has experienced an economic downturn in the past, similar to New England as a whole, during the mid-1980s Manchester was ranked number one in the nation in terms of business climate by U.S. News and World Report. During this same period, Inc. Magazine ranked the Manchester-Nashua area eighth out of fifty of the nation's fastest growing cities based on a four-year pattern of job generation, business start-ups, and number of rapidly growing firms. In fact, between 1990 and 1996, the Manchester PMSA generated approximately 18,900 jobs, an average annual growth rate of 4.3 percent.

In Londonderry, substantial increases in the number of job opportunities occurred during the 1970s and 1980s due to industrial growth in the Manchester Airport area, commercial development along NH 102 and NH 28, and increases in local government employment necessitated by dramatic population growth. Between 1990 and 1996, 6,300 manufacturing jobs were created, an increase of 610 percent. The majority of additional manufacturing sector job growth in Londonderry is expected to occur in the existing industrially zoned areas near the Manchester Airport in the northwest corner of town. New commercial job growth is expected to occur in proximity to NH 102, NH 28 near Exit 5, and between the Derry town line and the east side of I-93 south of NH 28. Development in these areas continues to be supported by Londonderry's 1997 Master Plan.

Table 3-11
1990 Average Annual Employment

	Rockingham County		Hillsborough County		Manchester PMSA		NH Portion Lawrence-Haverhill PMSA		Nashua PMSA	
Sector	Number	%	Number	%	Number	%	Number	%	Number	%
Manufacturing	15,430	17%	43,543	27%	11,104	15%	7,347	21%	30,930	37%
Construction & Mining	5,094	6%	6,036	4%	3,338	5%	1,986	6%	2,968	4%
Trans., Comm. & Utilities	4,143	5%	6,729	4%	3,566	5%	1,868	5%	2,233	3%
Trade	29,584	32%	40,344	25%	20,237	28%	12,369	35%	20,768	25%
Finance, Insurance & Real Estate	5,820	6%	11,372	7%	8,040	11%	1,134	3%	3,235	4%
Government	8,343	9%	11,296	7%	5,089	7%	2,986	8%	5,941	7%
Service & Other	22,949	25%	40,682	25%	21,803	30%	7,772	22%	18,523	22%
TOTALS	91,363		160,002		73,177		35,462		84,598	

Source: 1990 Profile, Employment and Wage Data, NH Employment Security, Economic and Labor Market Information Bureau, 1992
1990 County Profile, Employment and Wage Data, NH Employment Security, Economic and Labor Market Information Bureau, 1992

1996 Average Annual Employment

	Rockingham County		Hillsborough County		Manchester PMSA		NH Portion Lawrence-Haverhill PMSA		Nashua PMSA	
Sector	Number	%	Number	%	Number	%	Number	%	Number	%
Manufacturing	16,260	15%	40,304	23%	13,203	14%	6,324	16%	26,988	31%
Construction & Mining	1,209	1%	5,764	3%	4,000	4%	2,038	5%	2,795	3%
Trans., Comm. & Utilities	5,576	5%	6,213	4%	5,368	6%	1,131	3%	2,159	3%
Trade	36,289	34%	42,294	24%	22,749	25%	15,214	37%	21,892	25%
Finance, Insurance & Real Estate	4,843	5%	10,789	6%	7,709	8%	1,006	2%	3,300	4%
Government	11,406	11%	10,17,265	10%	9,950	11%	3,806	9%	7,470	9%
Service & Other	30,713	29%	51,163	29%	29,091	32%	11,087	27%	21,581	25%
TOTALS	106,266		173,792		92,070		40,604		86,185	

Source: 1996 Profile, Employment and Wage Data, NH Employment Security, Economic and Labor Market Information Bureau, 1998

Table 3-12
1990 Average Weekly Wages-Private Employment

<u>Sector</u>	<u>Salem</u>	<u>Windham</u>	<u>Derry</u>	<u>Londonderry</u>	<u>Manchester</u>	<u>Rockingham County</u>	<u>Hillsborough County</u>	<u>New Hampshire.</u>
Manufacturing	732.02	461.96	477.78	564.06	546.64	622.56	650.27	569.01
Non-Manufacturing	378.22	389.37	338.90	415.69	423.84	-	-	-
TOT PRIV'T EMPL	474.74	398.93	374.18	443.31	445.90	428.77	481.04	432.37

Source: New Hampshire Employment and Wages by Cities and Towns 1990, NH Employment Security, Economic and Labor Market Information Bureau, 1992

1996 Average Weekly Wages
Private Employment

<u>Sector</u>	<u>Salem</u>	<u>Windham</u>	<u>Derry</u>	<u>Londonderry</u>	<u>Manchester</u>	<u>Rockingham County</u>	<u>Hillsborough County</u>	<u>New Hampshire.</u>
Manufacturing	854.24	646.72	609.50	784.43	651.76	763.56	800.35	699.88
Non-Manufacturing	460.86	478.46	448.90	490.72	542.40	-	-	-
TOT PRIV'T EMPL	526.62	494.18	489.20	542.81	562.08	528.95	590.55	531.68

Source: 1996 County Profile, Employment and Wage Data, NH Employment Security, Economic and Labor Market Information Bureau, 1998

1990-1996 Annual Average Change in Average Weekly Wages
Private Employment

<u>Sector</u>	<u>Salem</u>	<u>Windham</u>	<u>Derry</u>	<u>Londonderry</u>	<u>Manchester</u>	<u>Rockingham County</u>	<u>Hillsborough County</u>	<u>New Hampshire.</u>
Manufacturing	2.8%	6.7%	4.6%	3.3%	3.2%	3.8%	3.9%	3.8%
Non-Manufacturing	3.6%	3.8%	5.4%	3.0%	4.7%	-	-	-
TOT PRIV'T EMPL	1.8%	4.0%	5.1%	3.7%	4.3%	3.9%	3.8%	3.8%

Salem's economic base experienced substantial expansion during the late 1980s. Between 1986 and 1989, Salem approved 24 retail projects, 31 industrial projects, 15 office projects, and the Rockingham Mall which was expected to account for 150 stores and 4 major anchors, and generate approximately 2,000 jobs. While currently developing at a slower pace, approved projects in 1997 and 1998 have included 7 retail projects, 4 industrial projects, 5 office buildings, 2 restaurants and 2 day care operations.

Windham is primarily a bedroom community, illustrated by the subdivision approval of 230 house lots in 1997 and 1998. It has the smallest employment of the five Study Area communities, with a 1990 average annual employment of 1,320. Employment opportunities in Windham are primarily limited to businesses located along NH 28 and NH 111, in West Windham and Windham Depot, in the town's industrial park off NH 111 near the Salem town line, and at numerous home occupations scattered throughout town.

In Derry, the shoe industry was, for many years, the mainstay of the Town's manufacturing sector. In 1965, this industry accounted for more than 80 percent of Derry's manufacturing employment. Derry has increasingly become a residential suburban community with almost three-quarters of its residents commuting out-of-town to work by 1980. Despite this shift, Derry continues to provide a substantial number of employment opportunities. In 1990, Derry provided approximately 1,450 manufacturing jobs, 1,550 trade sector jobs, and 1,930 services sector jobs.

3.10.4 Wages

Table 3-13 presents 1990 and 1996 average weekly wages by manufacturing and non-manufacturing sectors for each community within the Study Area as well as counties. **Table 3-14** presents the 1993 and 1996 average weekly wages by employment category for labor market statistical areas within which the Study Area communities lie.

In 1990, Salem had the highest average weekly wages for all employment (\$475) of the Study Area communities, while Derry (\$374) had the lowest. By 1996, Manchester had edged above Salem (\$562 vs. \$527), and Derry remained with the lowest (\$489).

1990 and 1996 industry-wide average weekly wages for Derry (\$374 and \$489) and Windham (\$399 and \$494) were below that of Rockingham County (\$429 and \$529) in which they are located. Salem's 1990 and 1996 average weekly wages (\$475 and \$527) compare to \$429 and \$529 for the County averages. 1990 and 1996 industry-wide average weekly wages in Londonderry (\$443 and \$543) were above Rockingham County average wages (\$429 and \$529). 1990 and 1996 average weekly wages in Manchester (\$456 and \$562) were below Hillsborough County (\$481 and \$591) (**Table 3-12**).

Table 3-13
Average Weekly Wages

Sector	1993				1996			
	<u>New Hampshire</u>	<u>Manchester MSA</u>	<u>Nashua PMSA</u>	<u>NH Portion Lawrence PMSA</u>	<u>New Hampshire</u>	<u>Manchester MSA</u>	<u>Nashua PMSA</u>	<u>NH Portion Lawrence PMSA</u>
Manufacturing	627.06	589.09	793.18	661.08	699.88	675.65	869.38	740.70
Construction	508.94	534.07	521.74	485.24	577.86	626.12	637.62	596.51
Trans., Comm. & Util.	605.71	675.41	487.45	415.40	660.66	754.31	548.23	499.15
Trade Retail	272.77	272.46	289.12	251.07	298.87	313.03	312.26	278.31
Fin, Insur & Real Est	586.90	624.36	578.50	489.31	676.95	700.31	658.49	599.56
Government	506.77	593.45	600.09	474.18	538.15	626.95	617.76	538.89
Service	446.73	487.26	471.14	478.25	498.53	538.12	544.79	520.68
ALL EMPLOYMENT	480.11	509.00	570.55	434.60	532.53	567.46	623.37	500.71

Source: 1993 Profile, Employment and Wage Data, NH Employment Security, Economic and Labor Market Information Bureau, 1998
 1996 Profile, Employment and Wage Data, NH Employment Security, Economic and Labor Market Information Bureau, 1998

1993-1996 Average Annual Change
In Average Weekly Wages

<u>Sector</u>	<u>New Hampshire</u>	<u>Manchester MSA</u>	<u>Nashua PMSA</u>	<u>NH Portion Lawrence PMSA</u>
Manufacturing	3.9%	4.9%	3.2%	4.0%
Construction	4.5%	5.8%	7.4%	7.6%
Trans., Comm. & Util	3.0%	3.9%	4.2%	6.7%
Trade, Retail	3.2%	5.0%	2.7%	3.6%
Fin, Insur & Real Est	5.1%	4.1%	4.6%	7.5%
Government	2.1%	1.9%	1.0%	4.6%
Service	3.9%	3.5%	5.2%	3.0%
ALL EMPLOYMENT	3.6%	3.8%	3.1%	5.0%

Table 3-14
Average Unemployment Wages

	1991 Average				Jan – Aug 1998 Average			
<u>Community / Area</u>	<u>Labor Force</u>	<u>Employment</u>	<u>Unemployment</u>	<u>Unemployment Rate</u>	<u>Labor Force</u>	<u>Employment</u>	<u>Unemployment</u>	<u>Unemployment Rate</u>
Salem	14,240	12,850	1,390	9.7%	16,731	15,918	814	4.9%
Windham	4,000	3,680	320	7.9%	5,738	5,475	263	4.6%
Derry	13,970	12,590	1,380	9.9%	19,154	18,474	668	3.5%
Londonderry	10,120	9,420	700	6.9%	12,449	12,148	301	2.4%
Manchester	58,620	53,930	4,690	8.0%	55,793	54,358	1,435	2.6%

NH Portion								
Lawrence PMSA	54,210	48,910	5,300	9.8%	73,814	70,779	3,035	4.1%
Nashua PMSA	99,160	91,780	7,380	7.4%	104,504	101,869	2,635	2.4%
Manchester PMSA	87,190	80,820	6,370	7.3%	101,690	99,201	2,489	2.4%
Rockingham County	132,160	121,650	10,510	8.0%	151,058	146,003	5,055	3.3%
Hillsborough County	187,580	173,430	14,150	7.5%	202,316	197,240	5,076	2.5%
New Hampshire	635,000	589,000	46,000	7.2%	653,998	635,698	18,300	2.8%

Source: 1991 and 1998 Local Area Unemployment Statistics Report, NH Employment Security, Economic and Labor Market Information Bureau, 3/25/92 and 9/24/98

Average annual wage growth continued in all labor market areas between 1993 and 1996. The range in relative wages for the various employment categories, however, is substantial and also continues. For example, within the Manchester MSA, average annual weekly wages for retail trade were \$272.46 in 1993 and \$313.03 in 1996, while finance, insurance and real estate's (FIRE) average annual wages were \$624.36 and \$700.31 for the same time periods. This illustrates a difference of 129 percent between retail and FIRE employment categories in 1990 and 124 percent in 1996.

In summary, manufacturing wages are high in Salem with its manufacturing being related to the Boston metropolitan area. Non-manufacturing wages, on the other hand, are higher in Manchester with its independent economic base.

3.10.5 Unemployment Rates

Unemployment rates for 1991, by county and statistical area, as well as for the state as a whole, are presented in **Table 3-14**. Unemployment rates in Rockingham County (8.0 percent) and Hillsborough County (7.5 percent) were slightly higher than for the state as a whole (7.2 percent). While the unemployment rate for the Manchester MSA (7.3 percent) was slightly higher than for the state (7.2 percent), the unemployment rate for the NH portion of the Lawrence, MA PMSA (9.8 percent) was higher still than for the state. The unemployment rate in the Nashua PMSA was slightly higher than for the state as a whole, at 7.4 percent.

Table 3-14 also depicts unemployment rates for each community in the I-93 Study Area. Derry and Salem, at 9.9 percent and 9.7 percent respectively, had the highest unemployment rates of the five I-93 Study Area communities. Manchester and Windham had the next highest unemployment rates at 8.0 percent and 7.9 percent respectively, both above the 7.2 percent statewide average. Londonderry (6.9 percent) was the only Study Area community that had an unemployment rate lower than for that for the state as a whole.

The January – August 1998 unemployment rates were substantially lower. Unemployment in the five towns ranged from 4.9% in Salem and 4.6% in Windham to 2.4% in Londonderry and 2.6% in Manchester. Unemployment in New Hampshire as a whole was 2.8% for the same period (see **Table 3-14**).

3.11 Existing Land Use

Existing land use patterns in the vicinity of I-93 are depicted on **Figure 3-8**. A summary of the land uses for each Study Area community follows:

3.11.1 Salem

Salem has experienced rapid residential and commercial growth in the areas adjacent to Exits 1 and 2 over the past twenty years. While Salem Depot used to be the focal point of development, the areas bounded by I-93 to the west and the Spicket River to the east have now become highly developed. Much of the growth has been residential, making Salem a residential community for employment centers along the I-495 corridor in Massachusetts, such as Lawrence, Lowell, and the greater Boston area.

The major commercial area in Salem is centered along the NH 28 corridor that runs parallel to I-93 on the east through much of Salem. With the opening of the Rockingham Mall in 1991 and the re-opening of Rockingham Park in 1990, the area near the I-93 Exit 1 Interchange and the intersection of Rockingham Park Boulevard with South Broadway (NH 28) has developed as a major commercial center in Salem. A secondary commercial center has also developed along Main Street (NH 97), which intersects NH 28 east of Exit 2.

Industrial development has occurred adjacent to the Interstate in several places. West of Exit 2 industrial uses are found along Keewaydin Drive, Manor Parkway and Industrial Way. East of the interchange is another industrial facility off Northeastern Blvd. Much of this area is occupied by the Digital Equipment Corporation facility. Industrial activity is also found along Lowell Road and Garabedian Drive near the Massachusetts border.

The majority of the developed land adjacent to the Interstate is single-family residential. The more densely developed areas tend to be in three locations -- two east of the Interstate and one west. Near Exit 1 there is an area bounded by the Interstate, Rockingham Park Boulevard and South Broadway (NH 28). Most of the development occurs off Kelly and Hasop Roads, as well as Haigh Avenue. Several of these areas are quite close to the Interstate. Across the Interstate to the west is another major residential area that includes the Salem Street area and a substantial development in the area of Cross Street. The Cross Street area is also very close to the Interstate. Further north on the east side of the Interstate is a residential area that closely follows South Policy Road. After crossing Main Street, the residential area expands to cover much of the area between North Policy Road and North Broadway (NH 28). A final residential area is found near the Windham town line on either side of the Interstate along Brookdale Road and South Shore Road, adjacent to Canobie Lake.

3.11.2 Windham

Windham is a suburban town that serves as a residential community for employment centers in Nashua, Manchester, Lawrence, Lowell, Haverhill, and the greater Boston area. Most of Windham's commercial businesses are located along NH 28 and NH 111. Business centers serving neighborhoods are scattered throughout the town. Windham's industrial uses are concentrated in the town's industrial park, located on Industrial Drive off NH 111 approximately 3/4 mile east of I-93 Exit 3.

The majority of developed land in Windham in close proximity to I-93 consists of residential land uses. The densest single family residential development is found around Cobbetts Pond, south of NH 111 and west of I-93; and between I-93 and Canobie Lake, to the east of I-93. The Cobbetts Pond/NH 111 neighborhood consists of a dense mix of seasonal homes, and cottages converted to year-round use. The residential neighborhood on the northwest shore of Canobie Lake comprises single family homes on 1/2- to 1-acre lots. Most of these homes were built after 1950. A relatively dense multi-family/condominium residential development is located just south of Exit 3 on Locust Road, adjacent to the west side of I-93 south of NH 111A (Range Road) and east of Cobbetts Pond.

The Jennys Hill area, off Searles Road east of I-93 where Searles Castle is located, is characterized by large lot single-family year-round homes built primarily during the 1980s. Clusters of residential development are also located in Windham Depot, just south of the Derry town line and west of I-93; along Morrison Road south of Windham Depot; and along North Lowell Road and County Road on the east side of I-93 south of Windham Depot. Some residences are also located in the median area along NH 111A (Range Road).

Commercial land uses within and adjacent to the Study Area are concentrated at Exit 3; between the northbound and southbound lanes of I-93, west and east of I-93 along NH 111 and NH 111A and along NH 111A (Range Road) in the I-93 median area. Industrial land use in the Windham portion of the Study Area is limited primarily to the Town's industrial park off NH 111, east of Exit 3.

3.11.3 Derry

Derry's town center, the most densely developed area, is located approximately 1 mile east of I-93 Exit 4, surrounding the intersection of NH 102 (Broadway) and NH 28. Derry is a suburban residential community characterized by a mix of single family, multi-family, and mobile home development. The Town's commercial uses are concentrated primarily in Derry's central business district, located just east of Exit 4 along NH 102.

Insert Figure

3-8 Land Use

(Sheet 1 of 2)

Insert Figure
3-8 Land Use
(Sheet 2 of 2)

Developed land in proximity to the Derry portion of the I-93 Study Area consists primarily of residential uses. Residential uses, which are in closest proximity to I-93, include the "Derryfield Road neighborhood" (located in the triangle formed by Kendall Pond Road, Fordway Avenue Extension, and the east side of I-93), Tracy Drive, and a cul-de-sac off of Beacon Hill Road on the west side of I-93.

Other important land uses in proximity to the Derry portion of I-93 include the town's sewage treatment lagoons located on the Derry-Londonderry town line, immediately to the east of I-93; and a number of agricultural uses and open fields located to the east and west of I-93, north of the Derry-Windham town line.

3.11.4 Londonderry

Londonderry is characterized primarily by single family residential and agricultural land uses, with concentrated areas of commercial and industrial enterprises as well as some multi-family development. The largest residential developments in Londonderry are located along the town's north-south axis roads including Boyd Road (from NH 102 south to the Hudson town line), High Range Road (from NH 102 north to Alexander Road), Mammoth Road (from NH 102 south to Beaver Brook), and Hardy and Gilcreast Roads (from Bancroft Road south to Beaver Brook).

Londonderry's largest concentration of commercial uses is located along NH 102 between Mammoth Road and the Derry town line in the vicinity of I-93 Exit 4. The town's industrial uses are concentrated in the vicinity of I-93 Exit 5 and in Londonderry's northwest corner in the Manchester Airport area. A large area of industrially zoned land (that is currently undeveloped) is located between I-93 and the Londonderry/Derry town line east of I-93. Should a local project to construct a new interchange (Exit 4A) be successful, this industrially zoned area would be an important industrial area as well.

In addition to residential, commercial, and industrial development, agriculture is an important land use in Londonderry. While land used for agricultural purposes is spread throughout town, the largest concentrations of active agricultural land are located west of I-93 between Pillsbury Road and NH 102. A large tract of agricultural land is located adjacent to the west side of I-93 just north of Exit 4. This tract, the Woodmont Orchards, is roughly 400 acres in size.

3.11.5 Manchester

Manchester serves as an employment, shopping, and service center for surrounding communities. The City is generally characterized by high-density commercial, industrial, and residential urban development in the City's central core area, surrounded on the fringes by suburban residential development. Land uses range from single family homes and neighborhood businesses to high rise multi-family housing, regional malls, and industrial facilities. The areas east of I-93 and south of I-293, as well as Manchester's

northwest corner, are the City's least developed sectors. Much of the area east of I-93 is part of the Massabesic Lake watershed, which serves as a water supply for Manchester and surrounding communities. A large percentage of this watershed land is owned by the Manchester Water Works.

Developed land in proximity to the I-93 Study Area consists of single family and townhouse condominium development. The largest concentrations of residential development, which lie in closest proximity to I-93, are located between Bodwell Road and the east side of the Interstate. This development includes Tall Pines, Woodedge Estates, Newton Meadow, The Briars, Cohas Station and Sundance Gardens apartments and/or townhouse condominiums. East of the Interstate between Bodwell Road and the City line, a number of residential developments have recently been constructed or approved. Existing residential developments in this area include East Meadow townhouse condominiums; Foxwood Village (single-family homes) on Pheasant Lane; as well as single family housing on Megan Drive, Wildflower Drive and Morning Glory Drive.

On the west side of I-93, the densest residential development is located between Bryant Road and the Interstate. Most of the land west of I-93 and south of Crystal Lake is currently undeveloped.

There are no known farms or agricultural uses within the vicinity of the Manchester portion of the I-93 Study Area.

3.12 Zoning

Zoning controls the potential use of land by limiting use to those which are allowed, or are conditionally allowed, and by promulgating development standards which, in turn, affect the cost and economics of development. Land within the I-93 Study Area is zoned for a variety of residential, commercial, and industrial uses with varying lot size, frontage, and other requirements. Zoning districts adjacent to I-93 within each town are described briefly below and depicted on **Figure 3-9**, Generalized Existing Zoning.

3.12.1 Salem

The Town of Salem is divided into thirteen (13) zoning districts:

- Rural
- Residential
- Garden Apartments
- Mobile Homes
- Commercial-Industrial C
- Highway-Commercial
- Industrial
- Business Office District I

Insert Figure
3-9 Zoning
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Insert Figure
3-9 Zoning
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- Recreational
- Commercial A
- Commercial-Industrial B
- Business Office District II
- Limited Community Shopping District

The majority of the land in proximity to the Salem portion of the I-93 corridor is zoned Commercial-Industrial B and Residential. More specifically, the area south of Rockingham Park Boulevard is zoned Rural or Residential, with the exception of the land which lies between the Spicket River and the Massachusetts state line east of I-93. This area is zoned Highway Commercial. The area adjacent to I-93 between Rockingham Park Boulevard and Brookdale Road is zoned Commercial-Industrial B. The area on either side of Rockingham Park Boulevard is zoned Commercial-Industrial C and a Residential District is sandwiched between this district and the Commercial-Industrial B District adjacent to the Interstate. One of the Town's two Industrial districts along Commercial Drive and Northwestern Boulevard is located immediately south of Brookdale Road on the west side of I-93. The area between Brookdale Road and the Windham town line is zoned Rural and Residential.

The generalized purposes of these zones within the I-93 corridor may be characterized as follows:

Rural	Single family residential with 2-acre minimum lot size
Residential	Single family residential with ½+ acre minimum lot size
Commercial-Industrial B	Retail, office, manufacturing, assembly, storage uses.
Commercial-Industrial C	Retail, office, manufacturing, assembly, storage uses and child care.
Highway Commercial	Retail and office uses.
Industrial	Office, research, assembly, manufacturing, hotel uses.

3.12.2 Windham

The Town of Windham has ten zoning districts:

- Rural
- Residence A
- Residence B
- Residence C
- Neighborhood Business District
- Business Commercial District A
- Business Commercial District B
- Business Commercial District C
- Limited Industrial District
- Historic District

Much of the Windham portion of the Study Area is zoned Rural. Areas zoned Residence A include the Cobbetts Pond and Canobie Lake shorelines and the Camelot Road/Sheffield Street area between North Lowell Road (Bridge Street) and I-93. Commercially zoned districts include the Windham Depot Neighborhood Business District at the Derry town line; a Business Commercial District B between the northeastern end of Cobbetts Pond and the west side of I-93 at Exit 3; and a Business Commercial District C zone in the median area south of NH 111 at Exit 3. In addition, Business Commercial District A zones are located in the median area north of NH 111 at Exit 3, on the north side of NH 111 west of the Interstate at Exit 3, and on the north and south sides of NH 111A east of I-93. Within the I-93 corridor, the Historic District includes the Searles School.

The generalized purposes of these zones within the I-93 corridor may be characterized as follows:

Rural	Single family residential with 50,000 square feet minimum lot size (in agricultural landscapes).
Residence A	Single family residential with 50,000 square feet minimum lot size (in residential landscapes).
Neighborhood Business District	Retail, office, restaurant uses.
Business Commercial District A	Business that serves the motoring and transient public.
Business Commercial District B	Business that serves the public.
Business Commercial District C	Business and industrial uses.
Historic District	Historic Commission reviews required.

3.12.3 Derry

The Town of Derry has the following seven zoning districts within the Study Area:

- Low/Medium Density Residential
- Medium/High Density Residential
- Manufactured Housing Park Development
- Industrial I
- Office Business District
- General Commercial
- Industrial IV

The area west of I-93 between the Londonderry and Windham town lines is zoned Low/Medium Density Residential. The entire east side of I-93 through Derry is zoned Industrial to a depth of at least 1,000 feet (Sections 1.260 and 1.280 in the Derry Zoning Ordinance), except for one Medium/High Density Residential district south of Kendall

Road. Derry's border with Londonderry, east of I-93, is primarily a combination of Medium/High Density Residential and Industrial, except for NH 102 that is fronted by the Office Business District.

The generalized purposes of these zones within the I-93 corridor may be characterized as follows:

Low/Medium Density Residential	Single family with 2-acre minimum lot size.
Medium/High Density Residential	Single and multi-family with 1-acre minimum lots.
Office Business District	Small retail, office and single family uses.
Industrial I	Manufacturing and open uses, like gravel pits.
Industrial IV	Retail, manufacturing and open uses, like gravel pits.

3.12.4 Londonderry

The Town of Londonderry has nine zoning districts:

- | | |
|--------------------------------|------------------|
| • Agricultural-Residential | • Commercial-III |
| • Residential-II | • Industrial-I |
| • Multi-Family Residential-III | • Industrial-II |
| • Commercial-I | • Conservation |
| • Commercial-II | |

While the majority of the Londonderry portion of the I-93 Study Area is zoned Agricultural-Residential (AR-I), the Londonderry portion of the Study Area also includes land zoned for higher density residential, commercial, industrial, and conservation uses. The area between I-93 and the Derry town line at Exit 4 is zoned Commercial-II; the area immediately west of I-93 at Exit 4 is zoned Commercial-I, II and III. The area just south of Exit 5 and NH 28 between the Derry town line and Stonehenge Road is zoned Commercial-II. Land zoned for industrial use includes Industrial-I districts between I-93 and the Derry town line immediately north of Ash Street (east of Exit 4), and the area just northeast of Exit 5. The only Industrial-II district in the I-93 Study Area is located east of the highway at Exit 5, along the Boston and Maine Railroad. Beaver Brook crosses I-93 near the Derry town line and is zoned Conservation.

The generalized purposes of these zones within the I-93 corridor may be characterized as follows:

Agricultural-Residential	Agricultural and single family uses.
Commercial I	General business uses.
Commercial II	Automotive related uses.
Commercial III	Office uses.
Industrial I	General industrial uses.
Industrial II	General industrial and automotive repair uses.
Conservation	Structures prohibited.

3.12.5 Manchester

The City of Manchester has nine residential districts, four business districts, four industrial districts, two civic districts, and one mixed-use district that includes the Millyard Historic District. The Manchester portion of the I-93 Study Area is zoned residential. More specifically, the area west of I-93 and south of Crystal Lake is zoned Residential Suburban (R-S), with the exception of the Bryant Road/Skyline Drive area which is zoned One-Family (R-1A). The area north of Crystal Lake to I-293 is zoned One-Family (R-1B). The area east of I-93, between Bodwell Road and the highway, is zoned Multi-family (R-3) and One-Family (R-1A) from just south of the Bodwell Road/Cohas Avenue/Hermit Road intersection north to I-293. East of Bodwell Road is a combination of residential zones, both single and multi-family.

The generalized purposes of these zones within the I-93 corridor may be characterized as follows:

Residential-Suburban	Single family residential with 40,000 s.f. minimum lot sizes.
One Family (R-1A)	Single family residential with 12,500 s.f. minimum lot sizes.
One Family (R-1B)	Single family residential with 7,500 s.f. minimum lot sizes.
Multi Family (R-3)	One and two family residential with 5,000 s.f. minimum lots.

The City does not anticipate any zoning district boundary changes within the I-93 Study Area.

3.13 Public Utilities

In addition to zoning controls, land development is influenced by the provision of public utilities. Water service relates to potential development density. With public water service, the economics for a higher development density and for non-residential uses desiring a higher level of fire protection are assisted. Development, particularly single family residential development, is not prohibited by the lack of a public water supply. Lack of sewer service combined with soil conditions, on the other hand, may prohibit higher densities due to the large amount of land required for disposal. Additionally, economics plays a part. Without a public system, the development itself must be of a large enough scale to cover the economic cost of a private sewer system. Lastly, gas service, which is provided by private corporations, has little affect on housing. It may, however, be an incentive for certain types of industrial and other larger non-residential developments.

3.13.1 Salem

The Town of Salem provides drinking water for public distribution throughout its developed area. Excluded, therefore, is the southwestern corner toward Pelham and the northeast area, north of Bluff Road and North Main Street.

Sewerage collection is provided in the center and southeast sections of town. Flow is to, and the treatment is at, the Greater Lawrence Sanitary District in Massachusetts.

Gas service, provided by Northern Utilities, is available in the South Broadway/I-93 area, on Main Street east to the Municipal offices on Geremonty Drive, in the industrial area west of Exit 2, including Industrial Way, Manor Parkway, Stiles Road and Keewaydin Drive, west a short distance on NH 38 (Lowell Road), and south on Cross Street to serve the industrial area on Garabedian Drive.

3.13.2 Windham

The Town of Windham provides neither water or sewer service. The Pennichuck Waterworks, Inc. purchased and now operates several private water systems previously owned by W & E Water Company. These systems are located in separated neighborhood developments, along NH 111A (Lowell Road) and extending on both sides of the Interstate, in the area of Rock Pond further south on NH 111A, on Bridge Street north of the Town Office, and off Fordway Avenue on the southern border with Derry. There is no public sewer service in Windham. There is no gas service in Windham.

3.13.3 Derry

The Town of Derry purchases water from Londonderry, (that having been purchased from Manchester) and provides for its public distribution throughout the developed area of town east of the Interstate and south down Beacon Hill Road, west of the Interstate.

Public sewer service is provided throughout the built-up area between the Interstate and NH 28 (South Main Street), to the east of the Interstate.

Gas service is provided by Energy North, along a portion of NH 28 (Rockingham Road), Crystal Avenue and Birch Street, to industrial users just to the west, along most of Tsienneto Street, along Pinkerton Street, and a portion of NH 102 (East Broadway) between NH 28 and NH 28A.

3.13.4 Londonderry

The Town of Londonderry is provided water service by both the City of Manchester and Pennichuck Waterworks, Inc., depending upon location. Current water service from Manchester is in the airport area and along Litchfield Road to the south, east across Grenier Field Road, to the northeast up Auburn Road and to the southeast down NH 28 (Rockingham Road) to the Derry town line. Pennichuck Waterworks, Inc., in turn, serves the southern half of Londonderry, with current service in the southeastern quarter of Londonderry, south of the electric transmission lines paralleling Shasta Drive, west of I-93, and north of South Road.

Public sewer service is found in northwest Londonderry, the area of the airport, east along Grenier Field Road, along Mammoth Drive, Rockingham Road and to the industrial area, just east of I-93 Exit 5. Sewer service extension is planned to go south down Mammoth Road to Pillsbury Road. Public sewer service is also provided on both sides of I-93, Exit 4, serving commercial and industrial uses. Gas is provided by Energy North to serve the airport area and extend down NH 28, crossing the Interstate at Exit 5 and continuing to Derry.

Gas service is planned for the northeast corner of Londonderry in the spring of 1999, extending from Manchester south on Bodwell Road.

3.13.5 Manchester

Manchester provides water service throughout its developed area. This includes the lightly developed area west of I-93, south of I-293 and east of NH 28 (South Willow Street).

Sewer service is provided throughout the developed area of central Manchester, north of I-293 and west of I-93. Service extends east of I-93 to serve the East Industrial Park Drive, just north of Island Pond Road and for one 3,300-foot section of South Mammoth Road, south of I-293 and west of I-93. There is also a private force main serving the southern-most subdivision (Rosegate Farm) off Bodwell Road, to the east of I-93.

Gas service by Energy North, in the area of the I-93 corridor, comes from East Industrial Park Drive, south along Cohas Avenue, and then along Bodwell Road to the Londonderry town line.

3.13.6 Other Utility Services

The Tennessee Gas Transmission Line runs north from Pelham on the Massachusetts border through Manchester. Its closest point to I-93 within the Study Area is approximately one mile west of exit 5 in Londonderry where it approximately follows NH 128 (Mammoth Road), crossing from one side to the other.

Major electrical transmission lines cross the Interstate in several locations, all in Londonderry. From south to north, these include a single set of lines just north of Pillsbury Road, four sets of lines just south of Stonehenge Road, and a single set of lines just north of Exit 5.

3.13.7 School Bus Routes

Laidlaw Transportation operates four school bus routes that utilize I-93 between Exits 1 and 3, although the morning southbound buses will on occasion detour to local streets to skirt traffic problems to which they have been alerted. The Interstate is also utilized for sporting events and field trips, and by Manchester bus drivers to get to the beginning of a scheduled bus route.

3.14 Community Environment

3.14.1 Community Facilities

A variety of community facilities are located within or near the municipalities that comprise the I-93 Study Area. These facilities are described briefly below for each community. The facilities near I-93 are identified in **Table 3-15** and shown on **Figure 3-10**.

3.14.1.1 Salem

Most of Salem's community facilities are located outside the I-93 Study Area. Many are clustered in the town center along Main Street (NH 97) and Geremonty Drive.

Exceptions to being distant from the Interstate are two schools, the abandoned sewage treatment facility, and the public works yard.

Police

The Salem Police Station is located on Veterans Memorial Parkway approximately 1 mile east of Exit 1, on the east side of NH 28.

Table 3-15
Community Facilities in the Interstate 93 Study Area and Vicinity

Salem	Fisk School
	Soule School
Windham	Searles School
Derry	Waste Water Treatment
	Transfer Station
	Public Works Garage
Londonderry	Town Offices
	Old Hill Graveyard
	Holy Cross Cemetery
Manchester	Green Acres Elementary School
	Green Acres Middle School
	Stowell Cemetery

Insert Figure

3-10 Community Facilities

(Sheet 1 of 2)

Insert Figure

3-10 Community Facilities

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Fire

Salem has three full-time manned stations -- the Central Fire Station off Main Street, the North Station in North Salem, and the South Salem Station on Lawrence Road. None of these facilities are located close to the Study Area.

Schools

Salem has five neighborhood elementary schools (grades 1 - 6) -- Soule School, North Salem School, Fisk School, Haigh School, and Barron School; a junior high school (grades 7-8); and a senior high school. Growth has been accommodated through school additions and a sixth elementary school that is being proposed for the northeast section of Town. While none of these facilities are located within the primary Study Area, Soule School and Fisk School are located in the near vicinity. Soule School is at the intersection of Clough Road and Kelly Road just south of Exit 1, which is about 1,500 feet east of the Interstate. Fisk School is on Main Street (NH 97) approximately 2,500 feet east of the Interstate and Exit 2.

Municipal Buildings

The Salem Municipal Building, which houses the town's administrative offices, is located in the Town Center Complex west of Exit 2 and outside the Study Area. The Municipal Court Building is located in the Town Center Complex adjacent to the Town offices.

Post Office

There are two post offices located in Salem. One, on South Broadway, serves Salem. The other, on East Broadway, serves North Salem.

Hospitals

There are no hospitals in Salem.

Libraries

The Kelley Library is located at the corner of Main Street and Geremonty Drive outside the Study Area.

Public Works

The Public Works Department is housed at the Cross Street facility just south of Exit 1, and adjacent to I-93.

Wastewater Treatment Facility

The wastewater treatment plant was located off South Broadway (Route 28) adjacent to the Spicket River in the south end of town, about 500 feet east of I-93. This facility has now been abandoned and Salem has joined the Greater Lawrence Sanitary District (GLSD).

3.14.1.2 *Windham*

Most of Windham's municipal facilities are located in the Church Street area off NH 111, approximately one mile west of Exit 3. None of these facilities, except Searles School and Chapel, are located in the Study Area.

Police

The Windham Police Station had been located west of North Lowell Road on NH 111. A new Police Station has been constructed and is occupied on Fellows Road, the south side of NH 111, opposite North Lowell Road.

Fire

The Windham Fire Department is currently located in the town center next to the Town Hall.

Schools

Two elementary schools -- Golden Brook (grades 1-4) and Center School (grades 4-6) -- and a middle school (grades 7-8) are located in Windham. The Town currently sends its high school students to Salem High School. All of these facilities are located outside the primary Study Area.

The Windham Cooperative Kindergarten, which used to be located in the Searles School Building, is a non-profit kindergarten and nursery school for children ages 3-6. The kindergarten has now moved to the old Police Station, just west of North Lowell Road on NH 111.

Castle College a private facility, east of Exit 3, has been closed.

Town Offices

The Windham town offices are located in two buildings in the town center on North Lowell Road, west of I-93.

Post Office

The Post Office is located on Cobbetts Pond Road, that runs between Lowell Road and NH 111A at the south end of Cobbetts Pond. This facility is located outside the primary Study Area.

Hospitals

There are no hospitals in the Town of Windham.

Libraries

The Nesmith Library was located in the town center on North Lowell Road. A new Nesmith Library has been constructed on Fellows Road, on the south side of NH 111, opposite North Lowell Road.

Museum

The old library building in the town center on North Lowell Road has become the Town's museum.

Other Public Buildings

The Searles School, opened in 1909, is located about ½ mile from I-93, on the south side of NH 111, east of Exit 3. This facility is an historic building and includes space for public gatherings, as well as grounds for a soccer field.

3.14.1.3 Derry

With the exception of the wastewater treatment facility, the solid waste transfer facility, and the public works yard, Derry's community facilities are well outside the I-93 Study Area.

Police

The Derry Police Department is located near Ross' Corner, east of I-93.

Fire

Derry's central fire station is located on East Broadway. The original fire station is on West Broadway in the center of West Derry, and the Island Pond Fire Station is on the corner of Warner Hill Road.

Schools

Derry has six schools -- Derry Village School, Floyd Elementary School, Grinnell School, South Range School, Hood Junior High School and West Running Brook Middle School. Pinkerton Academy, also located in Derry, is a private educational facility, contracted by Derry and adjacent communities to provide high school education.

Municipal Building

Some municipal offices are located at the former U.S. Postal Service Building at the corner of Broadway and Crystal Avenue and others are located at 40 Fordway. The Adams Memorial Building on Broadway is used for meeting room facilities and as the Town Office. The District Court that had been in the Adams Memorial Building has been replaced with a new facility on Manning Street.

Libraries

Derry's main Public Library is located on Broadway just west of Crystal Avenue. Taylor Library is located in East Derry.

Hospitals

Parkland Hospital Medical Clinic is located on Parkland Drive, off Birch Street in Derry. This facility is located approximately one mile east of Exit 4.

Post Office

During February 1999, the main Derry Post Office opened at a new location, Tsienneto Road and NH 28 Bypass. Its prior location on Crystal Avenue was a rented facility and remains as a private commercial use. A second post office facility is located on East Derry Road.

Public Works

The Public Works Department is located at 40 Fordway, about ¾ mile east of the Interstate.

Wastewater Treatment Facility

Derry's wastewater treatment facility is located on the Derry-Londonderry town line west of Beaver Brook, immediately east of I-93, just south of Exit 4. This site, at a slightly greater distance from the Interstate, includes Derry's solid waste transfer facility.

3.14.1.4 Londonderry

Most of Londonderry's municipal facilities are located on Mammoth Road (NH 128). These facilities are well outside the primary Study Area. Closer to the Interstate are the Town Office and Old Hill Graveyard.

Police

The Police Department is located on Mammoth Road, in what had previously been the Town Office. The school's administrative offices remain at this location.

Fire

Londonderry has three fire stations: the Central Station, on Mammoth Road north of the Library and Town Hall; North Station, on Mammoth Road three miles north of Central Station; and South Station, on Buttrick Road two miles south of Central Station.

Schools

Londonderry has three elementary schools: Matthew Thornton on Mammoth Road near Town Hall; South School, off South Road; and North School, on Rock Road. Londonderry Middle School and Londonderry High School are located on Mammoth Road near Town Hall.

Municipal Building

Londonderry Town Offices are located at 50 Nashua Road (NH 102), approximately ½ mile west of Exit 4.

Post Office

The Post Office is on NH 102, outside the Study Area.

Libraries

The Leach Library is next to the Police Station on Mammoth Road.

Hospitals

There are no hospitals in Londonderry.

Highway Department

The Londonderry Highway Department is housed in the Town Garage on High Range Road.

Cemeteries

There are two cemeteries close to I-93. Old Hill Graveyard is on the western side of Hovey Road, north of Exit 4, about 2,000 feet west of the Interstate. Holy Cross Cemetery is located on the eastern side of Gamache Road, south of Exit 4, about 800 feet west of the Interstate.

3.14.1.5 Manchester

Manchester is the most urbanized of the five I-93 Study Area communities. Many municipal facilities are concentrated in downtown Manchester, and others are scattered throughout the City. Community facilities include police, fire, school, hospital, library, and post office facilities. Manchester's southeast quadrant is one of the City's least developed areas. Thus, few community facilities are located in this area.

Community facilities located closest to the I-93 Study Area are; Stowell Cemetery, between Bodwell Road and the east side of I-93; and Green Acres Elementary and Middle Schools, located just north of I-293 and west of I-93, where these two highways meet.

Police

Police services are provided to the City from one main station house in downtown Manchester.

Fire

The City of Manchester operates nine fire stations located throughout the City. The Harvey Road Station, west of I-93 and south of I-293 on Harvey Road, is closest to the Study Area. This station provides first response to the southern and eastern portions of the City. The Fire Department has proposed the construction of two new stations. One of these stations is proposed for the City's southeast area, to be located east of I-93 and just north of I-293 at the intersection of East Industrial Park Drive and Island Pond Road.

Schools

Manchester's public school system is comprised of 15 elementary schools, a sixth grade only school, four middle or junior high schools, three high schools, and one high-school-level school of technology. Of these schools, Green Acres Elementary and Middle Schools are in closest proximity to the Study Area. They are situated just north of I-293 and west of I-93, and serve the southeast portion of the City.

City Hall

Manchester's City Hall and City Hall Annex are located in downtown Manchester. Many of the City's administrative offices are in these buildings, serving as the focal point of City government.

Post Office

Manchester's post offices are located downtown and off Goffs Falls Road.

Library

The City's main library, Carpenter Memorial Library, is located in downtown Manchester, while a branch library is located on the City's west side.

Hospital

Hospital facilities in Manchester include Catholic Medical Center, Elliot Hospital and Veterans Administration Hospital, all of which are outside the primary Study Area.

Cemeteries

The only cemetery close to the Interstate is Stowell Cemetery, located on the western side of Bodwell Road, about 300 feet east of the Interstate.

Airport

Manchester Airport straddles the Manchester/Londonderry municipal boundary west of I-93. It is the largest commercial air traffic facility in New Hampshire. Usage of the airport is increasing rapidly and continued growth is anticipated. There is a clear need for improved highway access to the airport to accommodate the existing and anticipated future growth of the airport. Highway access improvements have been under study for the last several years. A separate study is evaluating the selection of a corridor for highway access between the airport and US 3 (F.E. Everett Turnpike). Exit 5 was considered earlier in the study for improved access to the airport. It appears at this time that the airport's primary access will be from the F.E. Everett Turnpike.

3.14.2 Public Parks and Recreation Land

3.14.2.1 Section 4(f) Lands

Section 4(f) of the Department of Transportation Act of 1966 states “... special effort should be made to preserve the natural beauty of the countryside and public park and recreation lands, wildlife and waterfowl refuges and historic sites.” Regulations governing 4(f) implementation specify that there can be no taking of public park or recreation lands or impairment of wildlife and waterfowl refuges or historic sites without a thorough investigation into all prudent and feasible alternatives. Such alternatives may range from project modifications to “no build”. If it is determined that no prudent and feasible alternatives exist and that public park or recreation lands, wildlife and waterfowl refuges, or historic sites must be acquired or impaired, the FHWA must demonstrate that implementation of other alternatives would result in extraordinary cost, and/or social, economic, or environmental impacts. In addition, the proposed project or program must include all possible planning to minimize harm to the sites.

Park and recreational areas within or adjacent to the I-93 Study Area are listed in **Table 3-16** and shown in Figure 3-10, and briefly described by community.

Salem

There is one potential 4(f) park/recreation area in Salem located in proximity to I-93. Hedgehog Park, a 28.6-acre park, is used for a variety of canoeing, fishing, swimming, ice-skating, picnicking, horseshoes, volleyball, tetherball, and other recreational activities.

Another recreational facility, owned by the State, is the trail created from a portion of the Boston & Maine Corporation’s former railroad right-of-way. This trail begins at the Rockingham Park Boulevard, parallels NH 28 (North Broadway) and continues north into Windham. The Rockingham Recreational Trail is not a potential 4(f) facility in Salem because it is owned by the NH Department of Transportation (NHDOT) as a future transportation corridor, and is on loan to NH Department of Resources and Economic Development (NHDRED) for recreational purposes, until such time transportation improvements are needed.

One private recreational facility, located in the I-93 Study Area, is the Canobie Lake Fish and Game Club, located on the north side of NH 38 (Lowell Road) opposite Hedgehog Park. This club is private and, therefore, not a 4(f) facility.

Windham

Searles School represents both an historic building and a recreational resource (soccer field) protected by Section 4(f). It is located east of Exit 3. Neither the school or the soccer field are expected to be impacted by improvements to I-93.

As in Salem, the Rockingham Recreational Trail, owned by the State, is a trail created from a portion of the Boston & Maine Corporation's former railroad right-of-way. This trail continues from the town of Salem, through Windham Depot, to the Town of Derry. This trail is not a potential 4(f) facility, as it is owned by the NHDOT as a future transportation corridor, and is on loan to NHDRED for recreational purposes, until such time transportation improvements are needed.

There was also another railroad right-of-way, sections of which were abandoned in 1935 and 1942, running from Hudson to the northeast, through Windham Depot. This right-of-way owned by the NHDOT as a transportation corridor (but currently serves as a recreational trail called the Rockingham Recreational Trail) has been approved for transfer from NHDOT to Windham, subject to 2001 Town Meeting acceptance. If accepted, it will become a 4(f) facility.

Duncan's Beach in Windham, at the eastern end of Cobbetts Pond, is a private beach and is not, therefore, a 4(f) facility.

Derry

Potential 4(f) properties in Derry include two recreation trails located east of the I-93 Study Area. One is an as yet unnamed recreational trail, referred to as the B & M Corridor, generally running from the southwest to the northeast in the southern portion of Derry. The other is a portion of another as yet un-named recreational trail. This trail, a continuation of the Rockingham Recreational Trail generally paralleling the Interstate and referred to as the Recreational Corridor, was purchased by the Town from the railroad and is that portion of the Boston & Maine former railroad right-of-way from the Windham town line through the center of Derry and north to Madden Road. The portion of this right-of-way that continues north from Madden Road to the Londonderry town line was not purchased to be part of this trail as it shortly runs into the Interstate where it has been blocked. This short northerly portion is not, therefore, a potential 4(f) facility as it is still owned by NHDOT and designated as a future transportation corridor.

Londonderry

There are no park/recreation facilities identified within the general I-93 Study Area that could be potential 4(f) properties.

In Londonderry, the abandoned Boston and Maine former railroad right-of-way, owned by NHDOT, is cut off from the south by I-93 and severed by private land sales along the corridor. The right-of-way is not part of the Rockingham Recreational Trail, although it may be used for recreation "un-officially."

Manchester

Two City-owned park/recreational facilities are located near the I-93 Study Area in Manchester: Crystal Lake Park (17.8 acres), on the north end of Crystal Lake, and the

playing fields at Green Acres Elementary and Middle Schools, just north of I-293 and west of I-93.

Two privately owned recreational facilities are also located in the I-93 Study Area but are not subject to 4(f) criteria. These include: (1) the Boy Scouts of America's Camp Carpenter (135 acres according to Manchester Planning Department 1981 survey form) located in Manchester approximately ¼ mile east of I-93, at the end of Blondin Road and surrounding the southern half of Long Pond; and, (2) Melody Pines Day Camp, operating June to Labor Day, located on the southern shore of Crystal Lake.

3.14.2.2 Section 6(f) Lands

Section 6(f) lands are defined as lands that have been acquired or improved with funds provided by the federal Land and Water Conservation Act. The U.S. Department of the Interior, National Park Service has jurisdiction over these lands. Section 6(f) lands cannot be converted to another use without replacement by land that is of comparable value and use. The NH Department of Resources and Economic Development (DRED), Division of Parks and Recreation, list lands acquired or improved with Land and Water Conservation Funds in New Hampshire. A review of DRED's files indicate that two properties located in the I-93 Study Area qualify as Section 6(f) properties; they are Hedgehog Park in Salem and Crystal Lake Park in Manchester.

Hedgehog Park is a 28.6-acre park surrounding Hedgehog Pond. It is located in Salem on the south side of NH 38 (Lowell Road), about 2,500 feet west of the Interstate. This 28.6-acre park is used for a variety of recreational activities including canoeing, fishing, swimming, ice skating, picnicking, horseshoes, volleyball, and tetherball.

Crystal Lake Park is a 19-acre public property located on the north end of Crystal Lake at the intersection of Bodwell Road and Corning Road, just several hundred feet west of I-93. This park is a multi-use recreational area used primarily for swimming and boating.

Table 3-16
Public Parks and Recreation Areas, Section 4(f) Properties and 6(f) Lands in the Study Area and Vicinity

Salem	Hedgehog Park	4(f) and 6(f)
Windham	Rockingham Recreation Trail	4(f)
	Searles School (soccer field)	4(f)
Derry	B & M Railroad Corridor	4(f)
	The Recreational Corridor	4(f)

Londonderry	None	
Manchester	Green Acres Elementary and Middle Schools playing fields	4(f)
	Crystal Lake Park	4(f) and 6(f)

3.14.2.3 Manchester Open Space Lands

The City of Manchester's Open Space & Recreation Map (500-scale) was produced in 1998 by the Southern New Hampshire Planning Commission for the New Hampshire Land Conservation and Investment Program. There are seven areas listed in Manchester on the Open Space Map. The only one located adjacent to the Study Area is Great Cohas Swamp. It is located west of I-93 between NH 28A (South Mammoth Road) and NH 28 (South Willow Street), and is adjacent to the Great Cohas Brook. As such, it is outside the I-93 corridor Study Area. This swamp, however, is in the process of being protected through conservation easements resulting from Manchester's development permit granting process and the efforts of the NH Fish and Game Department.

There are no other listed areas in or near the I-93 Study Area.

3.15 Aesthetic and Visual Resources

3.15.1 Resource Features

The existing I-93 corridor is bordered for much of its length within the Study Area by forest growth. There are a few places that afford an extended view from the highway. Similarly, there are a few locations where the highway can be observed from a substantial distance.

There are several areas (primarily near the interchanges) where development is close to the existing roadway, with a limited, if any, buffer of natural vegetation between the land use activity and the highway. Potential areas that may be of scenic concern, especially if the buffer vegetation is disturbed, include land between the highway and Canobie Lake in Salem, Cobbetts Pond and Searles Castle in Windham and possibly Crystal Lake in Manchester.

Scenic resources listed in local community master plans and situated close to the highway corridor, include the following:

- A section of Brady Avenue in Salem, west of I-93, unofficially considered a scenic route,
- Some “open vista” areas identified in Derry’s Master Plan, and
- Woodmont Orchards in Londonderry.

It should be noted that the Brady Avenue designation is not formal and that some of the farmland that was the reason for its scenic character has been developed. Derry’s open vista areas have no official designation or protection. Portions of Woodmont Orchards have been sold for development. These areas are noted in **Table 3-17**.

No scenic easements are known to be associated with the existing highway in the Study Area.

Table 3-17
Other Public Resources in the Interstate 93 Project Vicinity

Salem	Brady Avenue scenic road
	Residential buffers
Windham	Canobie Lake Buffer
	Cobbetts Pond Buffer
	Residential buffers
	Searles Castle
Derry	Open vista to east
	Open vista to west
	Residential buffers
Londonderry	Woodmont Orchards
	Residential buffers
Manchester	Crystal Lake buffer
	Residential buffers

3.16 Future Land Use/Proposed Development: Potential Cumulative and Secondary Impacts.

The planning agencies of the Study Area communities were contacted in May/June 1992 to obtain an understanding of I-93's sphere of influence on land development patterns. Areas in proximity to the highway with potential for development were identified. An assessment of the influence of highway improvements on these parcels was sought from these discussions. The planning agencies in the Study Area were again contacted in November/December 1998 for data collection and in January 1999 to confirm earlier conversations and/or to record development changes in the communities.

3.16.1 Area Commuting Patterns

To understand the potential impact, improvements to I-93 may have on the surrounding area, consideration must be given to each community's place within the larger economic environment and to the commuting patterns of the region. Manchester and its suburbs, due in part to distance and travel time, are largely a self-contained urban economic area, less affected by the Boston metropolitan area. A listing of major manufacturers by location illustrates this economic fact. Manchester, itself, has more job opportunities than resident employees. Even still, over 37% of its residents work outside of Manchester. As the center of an urban economic area, the majority of this commuting is to the surrounding suburban towns, leaving only 6.2% of these employees who work in Massachusetts. Manchester's development of vacant parcels, as well as its redevelopment, will be much more dependent upon its own economy, and less affected by improvements to this Interstate segment. See **Table 3-18-Selected Commuting Patterns** and **Table 3-19-Major Manufacturers by Location**.

The other towns, however, are more tightly tied to the Boston metropolitan area. This situation is related to the towns' relative distance to the Massachusetts border. Starting at the more distant town of Londonderry and progressing through Derry, Windham and Salem, the percent of resident employees who commute to Massachusetts is 31.3%, 40.1%, 45.5% and 56.9%, respectively. Even Salem which appears to have almost as many jobs in town as it has resident employees, reports that 68.8% of its residents work out of town and that 82.9% of these commute to Massachusetts. Salem, Windham, Derry and Londonderry, both individually and as a group, exhibit these same characteristics. For these towns overall, 76.8% of residents commute out of their towns, and 57% of these commute to Massachusetts. In general, therefore, the Interstate's impact on the development of vacant residential parcels appears to be somewhat directly related to its real and perceived travel capacity toward the Boston metropolitan area and

its many employment opportunities. This would probably be true regardless of the parcel's location from the Interstate, as long as total travel time was not perceived to be substantially extended.

Land zoned for non-residential development will also be affected. Non-residential development closely related to the Boston metropolitan area's economy (for example, manufacturing one step removed from university research) will attempt to maintain a reasonable proximity relative to time and distance to the Boston metropolitan area. Direct access at interchanges will not be critical, but accessibility for employees and materials will be important. These historically were the types of non-residential uses that first migrated to MA 128, then I-495, and more recently into border towns like Salem. As Salem has fewer opportunities, this industrial development pressure tends to move northward to Windham, as is currently being reported. Non-residential developments serving a regional population base such as retail facilities, on the other hand, will focus on that population base and desire more direct access to the Interstate when considering their locations. These population-based developments deal with location opportunities, visibility, and ease of access, with the later developments requiring less direct access.

Some of the commuting patterns outside the primary corridor are also likely affected by this Interstate. The Towns abutting the study area to the north such as Bow, Hooksett, Candia, Raymond and Auburn show high commuting rates (80-87%), although with only 8-15% traveling to Massachusetts. This is most likely due to the intervening opportunities of both Concord and Manchester. To the western side of the corridor, Goffstown and Bedford have the same high commuting rates, with only 7-10% traveling to Massachusetts. As with the northern-most towns, there are many intervening employment opportunities.

The towns east of the Interstate corridor, Chester, Sandown, Danville, Hampstead and Atkinson show similarly high commuting rates (80-92%), but with 32-59% of commuters traveling to Massachusetts. These towns have fewer in-town jobs, and their residential growth will likely be affected by I-93.

On the western side of the corridor closer to the Massachusetts, Merrimack, Litchfield and Hudson have high commuting rates (70-94%), with 19-38% of commuters traveling to Massachusetts. This commuting pattern, however, is most likely affecting the F.E. Everett Turnpike, more easily accessed than I-93.

Also to the west is Pelham, with a 79% commuting rate, and with 72% of commuters going into Massachusetts. However, census specific destinations of Lowell and Dracut (69%) are more than twice as numerous as those of Andover and Boston (31%). These former destinations are in a direction away from I-93 and the latter, because of road patterns, more than likely relate to I-93 only within Massachusetts.

Table 3-18
Selected Commuting Patterns

Town	# Jobs In Town	# Resident Employees	# In-Town Jobs/ Employee		# Resident Employees Commute Out of Town	% Resident Employees Commute Out of Town	# Resident Employees Work in Massachusetts	% Resident Employees Commute to Massachusetts	% Resident Commuters Commute to Massachusetts
Manchester	59,413	50,999	116.5%		19,192	37.6%	3,163	6.2%	16.5%
Salem	13,727	14,095	97.4%		9,676	68.6%	8,019	56.9%	82.9%
Windham	1,725	4,726	36.5%		3,922	83.0%	2,149	45.5%	54.8%
Derry	6,817	16,409	41.5%		13,089	79.8%	6,584	40.1%	50.3%
Londonderry	<u>6,605</u>	<u>10,660</u>	62.0%		<u>8,536</u>	80.1%	<u>3,340</u>	31.3%	39.1%
Sub-Total	28,874	45,890	62.9%		35,223	76.8%	20,092	43.8%	57.0%
Bow	2,242	2,948	76.1%		2,584	87.0%	375	12.7%	14.5%
Hooksett	5,976	4,821	124.0%		3,858	80.0%	195	3.3%	5.1%
Candia	985	1,859	53.0%		1,617	87.0%	130	7.0%	8.0%
Raymond	1,821	4,298	42.4%		3,462	80.5%	520	12.1%	15.0%
Auburn	725	2,179	33.3%		1,882	86.4%	258	11.8%	13.7%
Goffstown	3,467	7,550			6 069	80.4%	424	5.6%	7.0%
Bedford	10,046	6,581			4,845	73.6%	465	7.1%	9.6%
Chester	401	1,455			1,169	80.3%	375	25.8%	32.1%
Sandown	354	2,207			1,960	88.8%	977	44.3%	49.9%
Danville	242	1,351			1,245	92.2%	636	47.1%	41.1%
Hampstead	1,449	3,554			2,962	83.3%	1,770	49.8%	59.8%
Atkinson	589	2,890			2,638	91.3%	1,566	54.2%	59.4%
Merrimack	12,311	12,569			8,838	70.3%	2,210	17.6%	25.0%
Litchfield	464	3,025	15.3%		2,854	94.3%	556	18.4%	19.5%
Hudson	10,469	10,932	95.8%		8,044	73.6%	3,091	28.3%	38.4%
Pelham	1,882	4,853	38.8%		3,838	79.1%	2,773	57.1%	72.3%

Source: New Hampshire Commuting Patterns: 1990 Census, NH Employment Security, Economic and Labor Market Information Bureau, August 1994, Revised November 1997

Table 3-19
Major Manufacturing (30 or more employees) by Locations

<u>Salem</u>	<u>Company</u>	<u>Address</u>	<u># Employees</u>	<u>Products</u>	<u>Company</u>	<u>Address</u>	<u># Employees</u>	<u>Products</u>
	Cornucopia Beverages, Inc.	S. Broadway	72	soft drinks	Prototype Circuits, Inc.	Delta Drive	32	printed circuit board
	Data Electronic Devices, Inc.	Bridge Street	50	contract manufact	Rally Products, Inc.	Hillside Avenue	30	safety glasses
	Hadco Corporation	Manor Parkway	1,700	printed circuits	Surprenant, Albert H.	Harvey Road	50	kynar and tefzel wire wrap products
	Hydroflow, Inc.	Northwestern Dr	32	liquid filtration sys	Uni Cast	Industrial Drive	110	alum invest castings
	Key Packaging Industries	Garabedian Dr	200	high density plastic blown sheeting	Workplace Systems, Inc.	Mammoth Rd	39	modular steel system
	Klein Associates, Inc.	Klein Drive	39	side scan sonar	<u>Manchester</u>			
	Magna Computer Corporation	Keewaydin Dr	57	computer products	Amherst International Corp.	Commercial St	78	vinyl/anti-static prod
	Memtec Corporation	Keewaydin Dr	30	tape storage devices & wire harness accessories	Anchor Electric	Bedford Street	150	meter mounting and service entrance equipment
	Micro-Precision Technologies	Manor Parkway	35	thick and thin film hybrid circuits	Arcadian Manufacturing Co., Inc	Elm Street	40	plastic heel finishers
	Parlex Corporation	Industrial Way	100	hybd thick film prod	Armtec Industries	French Drive	235	aircraft/industrial fire, pressure, wind sensors/systems
	Salem Screen Printers, Inc.	Delaware Drive	600	printing	Automatic Data Processing	Gay Street	40	payroll processing
	Standex International	Manor Parkway	5,000	electronic assembly	Blake's Creamery, Inc.	Millford Street	48	milk, cream products
	T L G, Inc.	Keewaydin Dr	30	portable electronic tactical systems	Budd Food Incorporated	Somerville St	55	frozen meat pies
	Turner's Dairy Inc.	Brady Avenue	30	milk/ice cream mix	Carol Cable Company	McGregor St	450	electronic cord sets
	Univex Corporation	Old Rockingham	100	food preparing mach	Caron Box and Lumber	Baker Street	35	wooden shooks, skids and pallets
<u>Windham</u>					Center Services, Inc.	Titus Avenue	250	contract assemb/pack
	Semiconductor Circuits, Inc.	Range Road	100	power supplies	Colortronix	South Willow	35	color separation
<u>Derry</u>					Crosfield Hastech, Inc.	Commercial St	200	graphic systems for newspapers
	Dynaco	Tinkham Drive	120	multilayer and rigid	Cummings, Lew A., Co., Inc.	Canal Street	90	book and commercial printers
	Eastern Rainbow, Inc.	Derry Ind Park	60	color separations	Cushcraft Corporation	Perimeter Road	100	communication and television antennas
	Galluzo, Anthony, Corp., The	Chester Road	30	arch millwork	Danais, John, Co.	Shasta Street	30	laundry and dry cleaning supplies
	Gentex Corporation	Tinkham Ave	35	electro-acoustic microphones	Deka Research and Development	Commercial St	80	medical equipment and environmental control
	Hadco Corporation	Manchester Rd	525	printed circuit bds	Disogrin Industries	Grenier Field	300	polyurethane seals, wheels and custom molding
	McCord Winn	Tinkham Ave	100	autom fuel pumps	Dupont Chemicals	Commercial St	190	electronics
	Merrimack Valley Wood Products	Derry Ind Park	125	millwork	E P E Corporation	Commercial St	200	electronic parts/equip
	Treasure Masters Inc.	Treasure Lane	200	gifts, fragrance, jewelry import/export	Easter Seals Society of NH	Auburn Street	225	contract assembling
<u>Londonderry</u>					Electronics Corp of America	Elm Street	215	combustion and photo electric controls
	AM Technology	Industrial Drive	33	contract manuf of PCB board assembly	Electropac	Willow Street	100	circuit boards
	Cadec Systems, Inc.	Perimeter Road	60	in-veh veh computer	EPE Technology	Commercial St	115	pick and place systems, wire wrapping equipment
	Lamont Labs, Inc.	Grenier Field Rd	100	cleaning chemicals	Felton Brush, Inc.	Wilson Street	160	industrial, appliance bush
	Nu-Cast, Inc.	Grenier Field Rd	36	alum invest castings	Fiber Processing Corporation	Perimeter Road	36	recycle wool/oth fiber
	P M C Corporation	Harvey Road	50	thermocouple and high temperature wire and cable	Fort Howard Corporation	Gay Street	200	injection molding

Table 3-19 Major Manufactures (30 or more employees) by Locations (Continued)

<u>Manchester</u>	<u>Company</u>	<u>Address</u>	<u># Employees</u>	<u>Products</u>	<u>Company</u>	<u>Address</u>	<u># Employees</u>	<u>Products</u>
	G T E Corporation	Willow Street	680	HID lamps	R C D Components, Inc.	Willow Street	385	wire wound, precision, specialty resisters
	Granite State Manuf Co., Inc.	Joliette Street	105	electro-mechanical contract manufacturing	R M Corp.	Zackary Street	36	circuit board assem
	Granite State Packing Co.	Hancock Street	175	meat packing	Signals Communication Corp.	Perimeter Road	75	commun antennas
	Granite Telcom Corporation	Industrial Pk Dr	30	telecommunication call processing products	Snow-Nabstedt Power Trans.	Joliette Street	100	industrial power
	Graphic Instruments	Ammon Drive	45	recorders universal mechanism with thermal printhead	Structures Unlimited, Inc.	Union Street	60	swimming pool
	H & O Dental Laboratory	Gay Street	70	dental appliances	Summa Four, Inc.	Sundial Avenue	80	telephone central office switching peripheral equipment
	Harvey Industries	Huse Road	270	replacement windows and doors	Summit Packaging Systems, Inc.	Ammon Drive	300	aerosol valves, contract injection molding
	Hermsdorf Fixture, Mfg. Co	Franklin Street	110	store fixtures	Sweetheart Plastics, Inc.	Gay Street	200	disposable food contain
	Hermsdorf Plastics	March Avenue	40	custom injected molded plastic products	T J F Beverages, Inc.	Industrial Drive	170	soft drink bottler
	Hitachi Cable Manuf, Inc.	Holt Avenue	105	non-ferrous wire forgings	Therrien A.W. Co.	Hayward Street	35	sheet metal/roofing
	Itran Corporation	Commercial St	50	vision inspect sys	Union Leader Corp.	William Loeb Dr	300	newspaper
	Jac Pac Foods	Hancock Street	275	portion control meat	Velcro U S A, Inc.	Brown Avenue	650	hook and loop fasteners
	Jewell Electronics Instruments	Grenier Field	150	digital panel meters, seisonic meters	Winwood Sportswear, Inc.	Commercial St	50	sportswear
	K R L Electronics	Bouchard Street	85	wire wound and power resisters	Zytronic, Inc.	Tirrell Road	60	electronic power
	Kalwall Corporation	Candida Road	275	fiberglass skylights and wall panels				
	Keller Products, Inc.	Union Street	90	plast//wood molding				
	Kered Clothing, Inc.	Commercial St	65	contract stitching				
	Klarman Rulings, Inc.	P O Box	30	reticles for optical instruments				
	Ladeco, Inc.	Dow Street	75	coil winding				
	Lafayette Beverages, Inc.	Pepsi Road	110	soft drinks				
	Lane Construction Corp., The	Dunbarton Road	40	bitum asphaltic conc				
	Laurier, Inc.	Industrial Park Drive	30	dispensers, hybrid die bonders, chip sorters				
	Leighton Machine Co.	Rogers&Hayw'd	75	knit/custom machine				
	Manchester Knitted Fashions, Inc.	Commercial St	425	knitted outerwear				
	Metal Works, Inc.	Gay Street	145	precision sheet metal				
	Micro Communications, Inc.	PO Box	30	waveguide and coaxial RF components				
	Moore Business Forms & Sys. Div	Brown Avenue	260	business forms				
	New Hampshire Plastics, Inc.	Bouchard Street	100	plastic sheet extruder				
	New Hampshire Sunday News	William Loeb Drive	300	newspaper				
	Nylon Corporation of America	Sundial Avenue	70	nylon resins				
	Protapac Co., Inc.	Willow Street	100	printed circuit board				

Source: George D. Hall Company, Directory of New England Manufactures 1993-1994, 1993.

3.16.2 Area Population Projections

The New Hampshire Office of State Planning makes projections by five-year intervals, age and sex projections by county, and net population growth by town. New Hampshire's population will age proportionally, as will population nationally, but the numbers in the workforce, aged 20 – 64, will continue to increase. This suggests that while a market change in products and services is possible, there will be more, not fewer, persons in the work force providing these products and services. Population projections by sex, on the other hand, will remain proportionally constant. See **Table 3-20** Population Projections by Age Cohort and **Table 3-21** Population Projections by Sex.

Population projections by town show that continuing growth is anticipated. From year 2000 to 2015, Salem should increase by 7,500 persons, Windham by 2,900 persons, Derry by 8,100 persons, Londonderry by 8,000 persons and Manchester by 7,600 persons. This growth should locate within each town relative to employment opportunities in accordance with previously discussed commuting patterns and relative to land availability within each town. A discussion of these land development trends, as related by local planning officials, follows (see **Table 3-22** Population Projections by Town).

3.16.3 Salem

Within the Town of Salem, several areas near I-93 are available for additional development. However, whether the improvement of the Interstate will provide the impetus for such development is not easily predictable. Some commercial or industrial expansion could be enhanced by capacity improvements that would facilitate more rapid access to certain sites near the interchanges.

Current development has proceeded without Interstate improvements. While the Town's total land capacity is for approximately two thousand residential building lots, six hundred have been subdivided in the last four years. There is now an annual 130 cap on the number of residential building permits issued. Two years ago, the cap was met in October. The 1999 cap was met by the middle of January 1999.

Several years ago, there appeared to be several possible sites for additional residential growth. One is near the Massachusetts border in the area adjacent to, and east of, Pond Street and Lawrence Road. However, this area is almost three miles by road from Exit 1, is small in size, has very awkward access and has seen little developer interest. It is unlikely that the improvement of I-93 would stimulate residential growth in this area because of its distance from the highway. Another available area west of the Interstate adjacent to Brady Avenue and Salem Street is on Salem's southern border and contains approximately 5,000 acres. This area has had some water and sewer extensions in the last several years, as well as resulting housing activity. Therefore, although this area

is over two miles from Exit 1 by road, it is possible with current commuting trends (68% of resident employees commute out of Salem and over 80% of these to Massachusetts) that improvement of I-93 would stimulate additional residential growth to the levels allowed.

At Exit 2, some available land exists off Pelham Road to the west of the interchange. Development potential is for approximately 100 lots. Although 1 – 2 miles from this exit, it is also possible with current commuting trends that the improvement of I-93 would stimulate additional residential growth in this area.

There are several commercial areas located near I-93, where improved access may have some affect on stimulating secondary growth. One is the Lowell Road commercial area. However, while the area is physically close to the highway, it is not directly accessible from Exit 1 so the affect would probably be minimal. In fact, over the last several years, this area has experienced non-residential development uses that are less dependent upon direct access and are mostly built-out. A more accessible area off Exit 2 is Fairmont Road. Although it is currently residential, improvement of the highway and the interchange might provide some stimulus for the area to be redeveloped as commercial. Currently, there has been discussion of a 100,000 square foot office project in this transitional area. A third location had been a commercial parcel south off Rockingham Park Boulevard in the Policy Brook area. This site, however, has been purchased for a park and ride parking lot.

Two industrial areas adjacent to the Interstate which were more likely to experience some stimulus from highway improvement, since goods and services can be delivered more readily, are almost totally built-out. One of these is the Raymond Avenue Industrial Park where there is one site available. This site is approximately one mile from the Interstate via Exit 2. The second is a site just west of Exit 2 off Pelham Road, to both the north and the south, where up to 2.6 million square feet of industrial space is available. Vacant land available for development, however, is now limited.

While these few non-residential opportunities are developed with Interstate dependent uses, South Broadway (NH 28) is experiencing redevelopment. This redevelopment is primarily retail and composed of nationally known chain stores. These retail uses, being distant from Interstate exits, appear to be less dependent on and less influenced by the Interstate.

Finally, the highway improvements may affect several roadways near the interchanges in Salem. As traffic increases, Rockingham Boulevard may require additional capacity be constructed along this roadway. Also, operation of the Salem Depot junction of NH 97 (Main Street) and NH 28 (North Broadway) will be further degraded by increases in traffic. How much of the future traffic will be the product of normal growth and how much will be drawn into the Study Area because of the improved capacity along the I-93 corridor is difficult to project. The Statewide Transportation Corridor Model indicates that average daily traffic volume at the State line will be approximately 137,000 vehicles

per day (vpd) in 2020 without the I-93 improvements, and 144,000 vpd with an 8 lane facility. The difference of 7,000 vpd is presumably what additional traffic is drawn to I-93 as a result of improving the highway with the capacity of I-93 improved. Some of these 7,000 vpd will be drawn from other local roads. Some will be the product of enticing people to come to New Hampshire given the improved transportation system.

Table 3-20
Population Projections by Age Cohort

New Hampshire										
	1990		2000		2005		2010		2015	
AGE	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
0-4 Years	84,565	7.6	73,898	6.0	71,721	5.5	75,169	5.5	80,980	5.6
5-20 Years	228,830	20.6	279,004	22.7	286,954	22.0	272,318	20.0	264,752	18.4
20-64 Years	670,828	60.5	728,099	59.3	787,512	60.3	830,539	61.1	871,729	60.6
65 or more	125,029	11.3	147,796	12.0	160,450	12.3	180,720	13.3	224,213	15.6
Totals	1,109,252	-	1,228,797	-	1,306,637	-	1,358,746	-	1,441,674	-
HILLSBOROUGH COUNTY										
	1990		2000		2005		2010		2015	
AGE	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
0-4 Years	27,151	8.1	23,487	6.3	22,310	5.6	23,273	5.6	25,278	5.7
5-20 Years	68,560	20.4	85,657	22.9	89,235	22.4	83,870	20.2	80,451	18.3
20-64 Years	205,933	61.3	223,762	59.8	241,507	60.6	255,098	61.5	268,692	61.0
65 or more	34,429	10.2	38,271	10.2	45,752	11.5	52,526	12.7	66,272	15.0
Totals	336,073	-	374,177	-	398,804	-	414,767	-	440,691	-
ROCKINGHAM COUNTY										
	1990		2000		2005		2010		2015	
AGE	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
0-4 Years	19,937	8.1	16,817	5.9	16,654	5.3	8,840	5.4	20,563	5.6
5-20 Years	49,905	20.3	65,196	22.9	68,403	21.9	64,909	19.4	63,677	17.3
20-64 Years	153,403	62.4	173,691	60.9	193,137	61.7	209,407	62.5	225,823	61.4
65 or more	22,600	8.9	29,438	10.3	34,883	11.1	42,711	12.7	57,558	15.7
Totals	245,845	-	285,142	-	313,077	-	335,203	-	367,621	-

Source: New Hampshire Population Projection for Counties by Age and Sex 2000-2020, New Hampshire Office of State Planning, April 1997.

Table 3-21
Population Projections by Sex

New Hampshire										
	1990		2000		2005		2010		2015	
AGE	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Male	164,450	48.9	184,094	49.2	196,518	49.3	204,580	49.3	217,409	49.3
Female	171,623	51.1	190,083	50.8	202,286	50.8	210,187	50.7	223,282	50.7
Totals	336,073	-	374,177	-	398,804	-	414,767	-	440,691	-

Source: New Hampshire Population Projection for Counties by Age and Sex 2000-2020, New Hampshire Office of State Planning, April 1997.

Table 3-22
Population Projections by Town

Community	1990	Average Annual Change 1990-2000	2000	Average Annual Change 2000-2005	2005	Average Annual Change 2005-2010	2010	Average Annual Change 2010-2015	2015
Salem	25,746	3,978	29,724	2,699	32,423	1,984	34,407	2,850	37,257
Windham	9,000	1,598	10,598	1,023	11,621	749	12,370	1,141	13,511
Derry	29,603	4,973	34,576	2,762	37,338	2,202	39,540	3,105	42,645
Londonderry	19,781	3,624	23,405	2,455	25,860	2,279	28,139	3,312	31,451
Manchester	99,332	6,619	105,951	3,898	109,849	2,072	111,921	1,612	113,533

Rockingham County	245,845	39,296	285,141	27,938	313,079	22,125	335,204	32,416	367,620
Hillsborough County	335,838	38,338	374,176	24,626	398,802	15,961	414,763	25,923	440,686
New Hampshire	1,109,117	119,677	1,228,794	77,844	1,306,638	52,112	1,358,750	82,918	1,441,668

Source: New Hampshire Population Projection: Total Population for Cities and Towns 2000-2020, New Hampshire Office of State Planning, October 1997.

3.16.4 Windham

As in Salem, current development has also proceeded without Interstate improvements. In 1997, the Planning Board approved 19 subdivisions, totaling 142 lots, 9 site plans, 15 lot-line changes and 13 special permits. In 1998, these approvals totaled 16 subdivisions with 88 lots, 10 site plans, 7 lot-line changes and 11 special permits. Windham's Building Department Director anticipates similar growth in 1999, as well as a planning re-evaluation of zoning and development controls along NH28 as it passes through Windham. This and private developer proposals are partially in response to Salem's limited capacity for additional non-residential growth.

Salem's reduced residential capacity likewise affects Windham's residential development. Residential development is expected to expand off of NH 111A (Range Road), west of the Interstate along the border with Salem and in the area between the Interstate and NH 28. Both of these areas have access to Exit 3. While these areas are over one mile from Exit 3, it is probable with current commuting trends (83% of resident employees work out of Windham and over half of these in Massachusetts) that the improvement of I-93 would stimulate additional residential growth.

In the median area of the interchange are two undeveloped parcels - one north of Indian Rock Road and one south. The northern parcel, for sale and zoned Business/Commercial is vacant, but very steep and difficult to develop. Attempts have been made to develop the southern parcel, but soil conditions for septic systems have made development difficult. Another consideration relative to developing these parcels for large commercial development involves access. Access would need to be from NH 111A and would require substantial improvements to that highway. Thus, while the proximity of these lots to I-93 is a positive factor for development, the physical constraints appear to make development difficult in the near future even with improved capacity along the I-93 corridor. Even so, a hotel and health club facility is investigating one of the sites. It should also be noted that the NHDOT may purchase much of this area to preclude development that would constrain alternatives for properly addressing I-93. Approval for such purchases was granted as part of the layout for reconstructing and relocating NH 111 east of I-93.

Another commercially zoned site is just west of the Interstate and south of the Castleton Conference Center off NH 111 (Indian Rock Road). However, the only current access is off NH 111A (Range Road), through Cobbetts Pond residential streets that are not adequate for commercial traffic.

East of Exit 3 at the intersection of NH 111 and NH 111A, an existing golf driving range, zoned Business/Commercial, is being subjected to consideration of more intensive uses.

A grocery, pharmacy and fast food development project has been proposed. As development pressure grows, improvements to I-93 and Exit 3 would make development in this area a more attractive proposition. There may also be some pressure for redevelopment of the commercial and residential uses.

Finally, there are three industrial sites off the interchange. One is the town's industrial park area (Industrial Drive), off NH 111. The second is further west on NH 111 where there is currently subdivision interest. The third is a site off Searles Road that currently needs access. This site, near NH 28, will probably be reconfigured when the town's zoning in this area is re-evaluated as is planned. All of these areas have or will have the potential for additional industrial development, substantially in response to Salem's limited capacity for additional non-residential growth. However, because of their distances from the interchange (greater than one mile), such development would likely not be stimulated solely by the expansion of the Interstate.

There is also a cumulative impact relative to the prospects for development in the Windham area as a result of the NH 111 Bypass, scheduled to begin construction in 2003. The improvements to NH 111 and NH 28 will likely enhance development potential in the area immediately east of I-93 and along NH 28.

3.16.5 Derry

Like other interchange areas in the I-93 Study Area, much of the land adjacent to Exit 4 in Derry is built out. Development in this area consists mostly of residential, commercial or institutional uses, including the Derry sewage treatment facilities and transfer station/landfill site on the Londonderry border south of the interchange. The one available public property connected with this area is probably only marketable to a single special use industry (the Town of Derry foresees a warehouse type use) due to its proximity to these facilities, relatively poor access, and the site's limited potential building area. Therefore, there is minimal likelihood for much secondary development as a result of improving I-93. However, one area with direct access to the highway may be affected. Broadway (NH 102) provides direct access from the interchange to downtown Derry; the existing commercial/residential area along this road may experience additional pressure to be redeveloped as non-residential. The town has recognized that this potential pressure currently exists and has, therefore, re-zoned a

portion of Broadway to Business/ Commercial, to encourage conversion of the residential properties to uses such as professional offices. Additional Broadway traffic possible from Interstate improvements, while not the only variable, may have some affect on the timing of additional conversions.

Several industrial areas may experience additional stimulus for development from the proposed highway improvements. However, all have rather poor access or other shortcomings, and two areas are a considerable distance from the interchange. The Town owns a 140-acre parcel, though only 12 acres are developable, adjacent to Kendall Pond Road and the Interstate. It is zoned industrial and has water and sewer available. The town would like to encourage a warehouse-type use. The most direct access to this site is actually by a circuitous route through Londonderry, via Gilcrest Road, from Exit 4. This property is currently under a marketing and development agreement with Derry Development and Preservation Corporation (DDPC). While newly provided highway visibility may assist, it is improbable that highway expansion will provide stimulus by itself to make this site attractive for development. Another large site is bounded by Kendall Pond Road, the abandoned railroad right-of-way and Windham Road. This site is over two miles from the interchange by road and contains a substantial amount of wetlands, including prime wetlands. Although zoned industrial, it lacks water and sewer. Also, due to its location and its surrounding land uses, it is anticipated that this area may have its industrial development potential re-evaluated. A third site north of the town center is also over two miles from the interchange. It, however, includes over 300 acres of vacant industrial land on either side of NH 28 and includes Derry Industrial Park as well as some retail uses. Because of the distance from the Exit 5 interchange and the fact that the site must be reached using local streets, this area is unlikely to be developed solely as a result of highway improvements to I-93. Currently, there is a study of a new interchange (Exit 4A) between Exits 4 and 5 to better serve this area. In summary, the characteristics of the existing non-residential development in this area suggest a lessened dependence upon the Interstate and reduced likelihood of secondary impact as a result of improvements to I-93. The development of an Exit 4A, however, might cumulatively result in some impact to the character and timing of this area's development.

The out-of-town commuting issue appears a little more obscure in Derry as the Interstate passes through only a corner of town. Even still, 40% of Derry's resident employees currently commute to Massachusetts, suggesting a dependency in the Interstate for this purpose. This situation relates to two areas of potential residential development. The previously mentioned industrial area, bounded by Kendall Pond Road, the abandoned railroad right-of-way and Windham Road may see a change to residential use. This area has had residential encroachment over time and is less than ideally located relative to present industrial standards. It is believed, therefore, that this area may have future pressure for conversion to residential zoning and additional residential development, with access on North Lowell Road to Windham and reasonable proximity to Exit 3. Further, there is also a great deal of residential development potential in the southern area of

Derry that would potentially be enhanced by improvements to the Interstate. Both of these locations are distant from the Interstate, but in general, albeit to a lesser degree, are potentially impacted by the improvements to I-93.

3.16.6 Londonderry

Londonderry has two interchanges: Exit 4 near the Derry town line and Exit 5 about 4 miles north. The improvement of I-93 could potentially subject areas near these interchanges to additional pressure for development or redevelopment, as well as increase the general level of accessibility for out-of-town commuting.

In general, the area around Exit 4 is built out, primarily with residential and commercial development. Close in to the west side of Exit 4, current market-driven development proposals include an office building, Home Depot and a 500-unit elderly housing project. On the western side of Exit 4, several industrial buildings are adjacent to the interchange and some land is available for commercial development. Currently, one commercial project has been proposed and the existing Park and Ride facility is to be expanded.

At Exit 5, a substantial amount of commercial/industrial development exists along Rockingham Road (NH 28). Should I-93 be improved and Exit 5 upgraded, this area may experience some additional growth and redevelopment of commercial uses. Currently, market-driven development proposals at Exit 5 include additions to the Coca-Cola facility and a new hotel. East of Exit 5 along Rockingham Road, there is a project to construct improvements that allow the Liberty Road industrial area to be accessed directly from Rockingham Road, instead of via Wilson Road. Notwithstanding these possibilities, it is probable that non-residential uses will be much more related to improved airport access from the F.E. Everett Turnpike than to I-93 highway improvements, and that there seems little likelihood that commercial/industrial growth would be stimulated to any great extent due to these Interstate improvements.

In terms of residential development, however, there may be some general affect throughout the community from I-93 highway improvements. In 1997, 80% of all resident employees commuted out of town, and 39% of these commuted to Massachusetts. A perception of easier commuting might encourage continued residential development throughout the community. This potential affect, however, may be tempered by implementation of Londonderry's 1997 Master Plan goal to increase its residents' in-town employment opportunities. Notwithstanding these possibilities, it seems unlikely that additional residential growth would be stimulated due solely to the Interstate improvements.

3.16.7 Manchester

Within the City of Manchester there appears to be little opportunity for secondary and cumulative growth from the potential improvements to I-93 in the Study Area. Although there may be a perceived benefit from provision of improved access, in reality there seems to be only a minimal likelihood that land adjacent to, or within a reasonable distance of the highway, would be subject to any additional pressure for development.

Several factors support this conclusion. First, the closest access to southeast Manchester -- the northern terminus of the project -- is actually in North Londonderry at Exit 5. From this point, there is relatively poor access to Manchester over narrow secondary roads. The closest area is served by Bodwell Road, parallel to the Interstate to the east until it crosses under the Interstate near the junction of I-93 and I-293. Most of Bodwell Road in Manchester is already developed with single- and multi-family housing. Residential developments, apartments and condominiums, have already been approved and developed in this general area. Further development is dependent upon the provision of sewer service. Lands further east are already committed to other uses, for example, Camp Carpenter Boy Scouts, or are controlled as part of the Lake Massabesic Watershed.

Exit 6, approximately two miles north of the northern terminus of the Study Area, may provide access to some vacant land suitable for residential development in the Hanover Street/Candia Road area. However, this area is considered too far from the Study Area to be subject to any substantial secondary impact. Manchester's own regional economy will have a much greater impact on any additional residential development in this area.

Further north, at Interchange 8, land is available for residential growth in the Wellington Road area east of the Interstate. Once again, this area is really too far from the Study Area to experience secondary impacts from the project.

West on I-293, the closest exit is the South Willow Street Interchange, almost two miles from the terminus of the Study Area. Much of this area is built out with commercial and residential uses. Any expansion or redevelopment of such uses as a result of improvements to I-93 is unlikely. These areas are too far from the Study Area to experience any secondary impacts.

3.17 Cultural Resources

A preliminary identification of historic and archaeological resources was completed in 1992 for the Salem to Manchester I-93 Study Area in the Towns of Salem, Windham, Derry, Londonderry, and the City of Manchester. This work was updated in 1998 (**Figure 3-11**). The study included a preliminary reconnaissance survey of historic structures, and a preliminary Phase I reconnaissance and intensive survey testing for any historic and prehistoric archaeological component.

The purpose of the investigation is to identify areas of sensitivity that may represent constraints to transportation improvements within the I-93 corridor. Locations of previously recorded prehistoric and historic archaeological resources and areas exhibiting archaeological sensitivity through reconnaissance and intensive survey were defined. This report summarizes the results of the intensive archaeological survey, with recommendations for further testing; and summarizes the preliminary historic structures survey, outlining areas for further study.

3.17.1 Regulatory Overview

Federal Requirements

Section 4(f) of the Department of Transportation Act of 1966

Section 4(f) of the Department of Transportation Act of 1966 states “...special effort should be made to preserve the natural beauty of the countryside and public park and recreation lands, wildlife and waterfowl refuges and historic sites.” Regulations governing 4(f) implementation specify that there can be no taking of public park or recreation lands or impairment of wildlife and waterfowl refuges or historic sites without a thorough investigation into all prudent and feasible alternatives. Such alternatives may range from project modifications to “no-build”. If it is determined that no prudent and feasible alternative exists and that public park or recreational lands, wildlife and waterfowl refuges, or historic sites must be acquired or impaired, the FHWA must demonstrate that implementation or other alternatives would result in extraordinary costs, and/or social, economic, or environmental impacts. In addition, the proposed project or program must include all possible planning to minimize harm to the sites.

National Historic Preservation Act

The National Historic Preservation Act (NHPA), as amended, was enacted by Congress in 1966 to ensure that historic buildings, neighborhoods, landscapes, and archaeological sites were considered in the ambitious post-World War II economic development programs. Through the NHPA, amended in 1976, 1980, and 1992, Congress sought to involve the federal government as an active participant in the Nation's preservation efforts.

Section 106 of the NHPA requires federal agencies to take into account the effects of their activities and programs on any historic district, site, building, structure, or object that is included, or eligible for inclusion, in the National Register of Historic Places. The agency must afford the Advisory Council on Historic Preservation (ACHP), established under Title II of the NHPA, a reasonable opportunity to comment on such actions.

The procedures followed in the Section 106 review are referred to as the "Section 106 process" and are set forth in regulations issued by the ACHP. The ACHP's regulations, *Protection of Historic Properties* (36 CFR 800) govern the Section 106 process. The ACHP does not have the authority to halt or abandon projects that will affect historic properties; rather, its regulations emphasize consultation among the responsible federal agency (in this case FHWA), the State Historic Preservation Officer (SHPO) and other interested parties, to identify, and if possible, to agree upon ways to protect the affected properties. In New Hampshire, the SHPO is also the Director of the NH Division of Historical Resources (NHDHR). The NHDHR is charged by RSA 227-C:9, Directive for Cooperation in the Protection of Historic Resources, to coordinate the identification and evaluation of cultural resources in the State of New Hampshire.

State Requirements

NH Division of Historical Resources Guidelines

The NHDHR has developed guidelines to assure that the project's development meets the requirements of the historic preservation review process. The purpose of these guidelines is to 1) locate and identify historical, architectural and archaeological resources within a proposed Study Area; 2) apply the criteria for evaluation of resources for potential inclusion on the National Register of Historic Places; 3) assess the potential effects a proposed project may have on properties listed on, or determined eligible for, the National Register of Historic Places (NRHP).

Insert Figure

3-11 Cultural Resources

(Sheet 1 of 2)

Insert Figure

3-11 Cultural Resources

(Sheet 2 of 2)

The NHDHR has prepared Procedures for Identifying Cultural Resources That May Be Affected By State or Federal Transportation Projects in New Hampshire, dated November 25, 1992. This document offers specific guidance for cultural resource survey efforts undertaken as a component of transportation improvement projects.

3.17.2 Historic/Architectural Resources

PAL (Public Archaeology Laboratory) completed the architectural reconnaissance roadway survey update of the proposed I-93 improvement project area in August 1998. The field survey was undertaken in a 500-ft width to either side of the highway, and extended approximately 3,000 feet down intersecting roadways at Exits 1 through 6. The purpose of the survey was to update the previous survey of the project area conducted by PAL in 1993, using new mapping.

Table 3-23 and **Figure 3-11** describe and locate the 155 pre-1950 potentially historic properties identified in the survey. In addition to locational information, the table provides information on estimated date of construction, architectural style, construction materials, condition, and integrity. Furthermore, a breakdown of the number of buildings by period of construction is presented. The preliminary fieldwork was a windshield survey, and the results (especially the dates of construction) are based solely on field observations and thus are subject to refinement pending additional research.

Potentially historic properties will be reviewed to determine their eligibility for listing in the National Register of Historic Places. The Determination of Eligibility process will require further evaluation of the potential resources to evaluate these properties against the National Register criteria, their physical integrity and their significance within historic context. Each of these properties will be evaluated at Determination of Eligibility meetings where a consensus determination will be made as to their eligibility. These reviews will be attended by the NH State Historic Preservation Officer, the NH Division of Historic Resources, the Federal Highway Administration, and the NH Department of Transportation. It is possible that the majority of the potential resources identified will not be determined eligible due to the resource not meeting the National Register criteria.

The results incorporate 31 buildings previously identified in 1990. Two properties included in the 1993 survey could not be located (a depot at Trolley Car Lane, which was not located by the 1993 field crew, and a barn on South Shore Road, which was listed in poor condition in 1993 and may have been demolished). Three resources have been demolished since 1993. One resource, a series of four cottages off NH 111 in Windham, surveyed in 1993, was evaluated as less than 50 years old. Six properties not surveyed in 1993 that are located within the corridor and appear to be 50 years old or older have been added.

Of the previously surveyed properties several had been surveyed individually or included as part of a survey area by others, as follows:

- An area in Windham includes 20 properties along and off of NH 111 and NH 111A. Of these properties, 6 buildings are also included in a smaller area along Range Road.
- An area in Windham includes a number of properties around Canobie Lake which are considered potentially eligible for the NRHP.
- An area in Windham is designated the Searles Castle Historic District, which is considered eligible for listing in the National Register of Historic Places (NRHP). Within the district are two listed properties, Searles School and Chapel (listed in 1982). Searles Castle is located a short distance up Searles Road and is about ¼ mile east of the Interstate. It was constructed by Edward Searles on Jenny's Hill in the late 1800's. Searles School, previously mentioned, was constructed and traded by Edward Searles in exchange for property on which Schoolhouse #1 was located and which was surrounded by other Searles property. Searles Castle is a private facility, but is historic and consequently a 4(f) resource from that perspective.
- A large area in Manchester includes approximately 30 of the properties included in Table 3-23. These properties are not specifically mentioned in the area form, but based on their location within Manchester, it is likely they fall within the district. The only properties specifically mentioned (briefly) in the area form are 500 Bodwell Road (Property #6) and the Bandstand at Crystal Lake (Property #12).
- 12 properties in Windham have individual survey forms.

Summary of Historic/Architectural Resources Survey

Time Period	Building Count
1700-1775	3
1775-1830	9
1830-1880	23
1880-1920	62
<u>1920-1950</u>	<u>58</u>
Total	155

Table 3-23
Pre-1950 Potentially Historic Properties in Survey Area

Property No.	Address	Community	Approx. Date	Style/Form	Materials	Condition	Integrity
Exit 6							
1	181 Bodwell Road	Manchester	ca. 1940	cape	vinyl siding	good	medium to high
2	Bodwell Road	Manchester	ca. 1900	No Style	multiple artificial	very altered	low
3	193 Bodwell Road	Manchester	ca. 1940	cape	wood clapboard	good	medium to high
4	200 Bodwell Road	Manchester	ca. 1940	cape	vinyl siding	good	low
5	211 Bodwell Road	Manchester	ca. 1940	cape	vinyl siding	good	low
6	500 Bodwell Road	Manchester	early 19th century	-Federal	vinyl siding	very altered	low
7	516 Bodwell Road	Manchester	ca. 1840	Greek Revival	brick veneer and vinyl siding	very altered	low
8	521 Bodwell Road (house and barn)	Manchester	ca. 1870	Italianate	wood clap-board	good	medium
9	534 Bodwell Road	Manchester	ca. 1940	cape	vinyl siding	good	medium to high
10	595 Bodwell Road	Manchester	ca. 1950	No Style	stucco, brick, metal	fair	low
11	718 Bodwell Road	Manchester	ca. 1900	No Style	vinyl siding	very altered	low
12	Bandstand at Crystal Lake	Manchester	ca. 1910	Craftsman	stone/wood	very good	high
13	876 Bodwell Road (Gilbert Farm)	Manchester	ca. 1910	Craftsman	wood clap-boards	very good	high
14	539 Brickett Road (house and barn)	Manchester	ca. 1900	No Style	asbestos shingles	good/ altered	low

Table 3-23 Pre-1950 Potentially Historic Properties in Survey Area (Continued)

Property No.	Address	Community	Approx. Date	Style/Form	Materials	Condition	Integrity
15	168 Bryant Street	Manchester	ca. 1920	cape	vinyl siding	good	medium to high
16	308 Cohas Avenue (house and 2 barns)	Manchester	ca. 1860	Greek Revival	vinyl siding	good	medium
17	333 Cohas Avenue	Manchester	ca. 1920	Dutch Colonial Revival	wood shingles	good/ altered	medium
18	679 Island Pond Road /Cohas Avenue	Manchester	early 19th century	Federal	asbestos shingles	fair	medium
19	373 Mammoth Road	Manchester	ca. 1870	Italianate/ No Style	wood shingles	fair	medium
20	378-380 Mammoth Road	Manchester	ca. 1870	Italianate	asbestos shingles	fair	high
21	401 Mammoth Road	Manchester	ca. 1840	Greek Revival	asbestos shingles	very altered	medium to low
22	69 Mooresville Road	Manchester	ca. 1920	Foursquare	vinyl siding	good	medium
23	135 Mooresville Road (house & garage)	Manchester	ca. 1910	Craftsman	vinyl siding	good	high
24	178 Old Cohas Avenue (house w/ attached barn)	Manchester	ca. 1850	Greek Revival	vinyl siding	good	medium to high
25	759 Spring Road	Manchester	ca. 1900	cape	asbestos shingles	good	high
26	Spring Road	Manchester	ca. 1900	cape	wood shingles	good	high
27	781 Spring Road	Manchester	ca. 1900	cape	wood clap-boards	good	medium to high
28	784 Spring Road	Manchester	ca. 1900	No Style (hipped roof)	wood shingles	good	low
29	787 Spring Road	Manchester	ca. 1900	cottage	wood clap-boards	good	medium to high
30	95 West Shore Avenue (house and garage)	Manchester	ca. 1930	cottage	wood	fair	medium

Table 3-23 Pre-1950 Potentially Historic Properties in Survey Area (Continued)

Property No.	Address	Community	Approx. Date	Style/Form	Materials	Condition	Integrity
Exit 5							
31	Rte. 28 (house and barn)	Londonderry	ca. 1850	Greek Revival	wood clapboards	poor/dilapidated	medium
Exit 4							
32	30 Buyck Avenue	Londonderry	ca. 1900	cottage	wood shingles	poor to fair	low
33	1 Garden Lane	Londonderry	ca. 1920	No Style/ outbuilding	wood clapboards	poor/dilapidated	low
34	2 Garden Lane	Londonderry	ca. 1910	Craftsman	wood shingles	fair	medium
35	4 Londonderry Road	Londonderry	ca. 1940	cape	vinyl siding	good	medium
36	6 Londonderry Road	Londonderry	early 20th century	wood clapboards Dutch Colonial Revival	fair to good	medium	
37	9 Londonderry Road	Londonderry	ca. 1930	cape	vinyl siding	fair	low
38	10 Londonderry Road	Londonderry	ca. 1890	Queen Anne	vinyl siding	very good	medium
39	117 N. Lowell Road (at bridge)	Windham	ca. 1870	Italianate with additions	asbestos shingles	fair to good	medium
40	School House on Reo Lane	Londonderry	early 20th century	Classical Revival	brick	fair	medium
41	1 Trolley Car Lane	Londonderry	ca. 1870	cottage, Italianate	wood shingles	very good	medium
42	44 Trolley Car Lane	Londonderry	ca. 1930	cottage “log cabin”	vinyl siding	good	low
43	63-65 Brookdale Road	Salem	ca. 1900	cottage	wood shingles	good	medium
44	64 Brookdale Road (garage in corridor)	Salem	ca. 1950	ranch	wood clapboards	good	medium
45	Brookdale Road	Salem	ca. 1940	cottage	asbestos siding	poor to fair	low to medium
46	70 Brookdale Road	Salem	ca. 1850	Greek Revival	wood shingle/clapboard	good	medium

Table 3-23 Pre-1950 Potentially Historic Properties in Survey Area (Continued)

Property No.	Address	Community	Approx. Date	Style/Form	Materials	Condition	Integrity
47	George Dinsmore House 86 Indian Rock Road (NH 111)	Windham	ca. 1924	Craftsman	stone	good	high
48	Bradley's Store 54 Range Road	Windham	ca. 1935	No Style	wood clapboard	fair	medium to low
49	Hameon's Garage 55 Range Road (NH 111A)	Windham	ca. 1945	No Style	stone veneer	poor/ very altered	low
50	Park/Dinsmore House 59 Range Road (NH 111A)	Windham	ca. 1812	Federal/Second Empire	painted brick	very good	medium to high
51	Katchadorian House 61 Range Road (NH 111A)	Windham	ca. 1940	Colonial Revival	wood shingles	good	medium to high
52	Joseph Park House 64 Range Road (NH 111A)	Windham	1742 (from plaque)	Federal	wood clapboards	very good	medium to high
53	67 Range Road (NH 111A)	Windham	ca. 1940	cape	wood clapboards	good	medium
54	82 Range Road (NH 111A)	Windham	ca. 1920	cape	wood clapboards	fair	medium
55	Sally Park House 85 Range Road (NH 111A)	Windham	ca. 1799	Federal/ cape	asbestos shingles	good	medium to low
56	George F. Armstrong House 86 Range Road (NH 111A)	Windham	ca. 1884	Italianate	wood clapboards	good	medium to high
57	Robert Armstrong House 88 Range Road (NH 111A)	Windham	ca. 1810	Federal	wood clapboards	very good	high
58	91 Range Road (NH 111A)	Windham	mid-19th c./ moved c. 1965	No Style	wood clapboards	good	medium

Table 3-23 Pre-1950 Potentially Historic Properties in Survey Area (Continued)

Property No.	Address	Community	Approx. Date	Style/Form	Materials	Condition	Integrity
59	Joseph W. Dinsmoor House/ "Lakeview" 94 Range Road (NH 111A)	Windham	ca. 1884	Queen Anne	wood clapboards	good	high
60	Thom/ Dinsmoor 95 Range Road (NH 111A)House	Windham	ca. 1733	Georgian cape with 1930s additions	wood clapboards	very good	medium
61	1 Water's Edge Road	Windham	ca. 1920	cottage	asbestos shingles	good	medium
62	Water's Edge Road	Windham	ca. 1920	cottage	asbestos shingles	good	medium to high
63	3 Water's Edge Road	Windham	ca. 1920	ranch/ cottage	wood clapboard	good	medium
64	5 Water's Edge Road	Windham	ca. 1920	ranch/ cottage	wood shingles	good	medium
65	behind conference center on Cobbett's Pond	Windham	ca. 1920	cottage	wood clapboards	good	medium to high
66	33 South Shore Road	Salem	ca. 1920	cottage	wood shingles	good/altered	medium
67	35 South Shore Road	Salem	ca. 1940	cottage	vinyl siding	good	medium
68	South Shore Road	Salem	ca. 1920	cottage	wood shingles	good	medium to high
69	South Shore Road (house and barn)	Salem	ca. 1900	cottage	wood clapboards	good	medium to high
70	South Shore Road	Windham	ca. 1920	cottage	vinyl siding	good	medium to low
71	102 South Shore Road	Windham	ca. 1900	cottage	aluminum siding	good	medium to low
72	South Shore Road	Windham	ca. 1900	cottage	wood shingles	good	medium to low
73	South Shore Road	Windham	ca. 1840	Greek Revival	aluminum siding/new windows	good/ altered	medium to low

Table 3-23 Pre-1950 Potentially Historic Properties in Survey Area (Continued)

Property No.	Address	Community	Approx. Date	Style/Form	Materials	Condition	Integrity
74	South Shore Road	Windham	ca. 1920	cottage	vinyl siding	good	medium to low
75	112 South Shore Road	Windham	ca. 1920	cottage	shiplap siding	fair	medium
76	115A South Shore Road	Windham	ca. 1920	cottage	asbestos shingles	fair	medium
77	South Shore Road	Windham	ca. 1930	cottage	wood shingles	good	medium to low
Exit 2							
78	Bowyer Lane	Salem	ca. 1900	cottage	board and batten	fair	medium
79	Bowyer Lane (house with barn)	Salem	ca. 1830	Federal/ Greek Revival	asbestos shingles	good	medium
80	3 Clinton Street	Salem	ca. 1920	cape	asbestos shingles	good	medium
81	6 Clinton Street	Salem	ca. 1900	Colonial Revival	vinyl siding	good/ altered	medium to low
82	7 Clinton Street	Salem	ca. 1890	Queen Anne	vinyl siding	good	medium to high
83	8 Clinton Street	Salem	ca. 1910	Craftsman	wood shingles	good	medium
84	11 Clinton Street	Salem	ca. 1890	Colonial Revival	vinyl siding	good	medium to high
85	12 Clinton Street	Salem	ca. 1890	Queen Anne	vinyl siding	good	medium
86	2 Fairmont Road	Salem	ca. 1890	Queen Anne	wood clapboards	good	medium to high
87	8-10 Fairmont Road (2 family)	Salem	ca. 1920	Colonial Revival	vinyl siding	good	medium to high
88	19 Fairmont Road	Salem	ca. 1900	cottage	wood shingles	fair	medium
89	20 Fairmont Road	Salem	ca. 1905	Colonial Revival gambrel	asbestos shingles	fair/ altered	medium to low
90	21 Fairmont Road	Salem	ca. 1800	Federal cape	wood clapboards	good	medium
91	Fairmont Road	Salem	early 20th century	cottage	vinyl siding	fair	medium

Table 3-23 Pre-1950 Potentially Historic Properties in Survey Area (Continued)

Property No.	Address	Community	Approx. Date	Style/Form	Materials	Condition	Integrity
92	136 Kelly Road	Salem	ca. 1850	Greek Revival	asbestos shingles	fair	medium to low
93	27 Lowell Road	Salem	ca. 1900	cape	asbestos shingles	good	low
94	31 Lowell Road	Salem	ca. 1940	cape	vinyl siding	good	medium to low
95	32 Lowell Road	Salem	ca. 1910	Craftsman bungalow	wood shingles	good	medium to high
96	2 Main Street	Salem	ca. 1840	Greek Revival/ Italianate	stone, wood clapboards	good	medium
97	3 Main Street	Salem	ca. 1870	Italianate	asbestos shingles	good/ altered	medium
98	5 Main Street	Salem	ca. 1890	Colonial Revival	wood clapboards	good	low
99	11 Main Street	Salem	ca. 1880	Italianate	asbestos shingles	fair/altered	medium
100	50 North Policy Road (house and barn)	Salem	1757 (plaque)	Federal	vinyl siding	very good/ altered	medium
101	25 Pelham Road	Salem	ca. 1930	cape	asbestos shingles	fair	medium
102	26 Pelham Road (house with barn)	Salem	early 19th century	Italianate/cape	vinyl siding	fair	medium
103	27 Pelham Road	Salem	ca. 1900	cape	vinyl siding	fair	medium (hard to see)
104	43 Pelham Road	Salem	ca. 1850	Greek Revival	wood clapboards	rehab	low
105	2 Point A Road	Salem	early 20th century	Colonial Revival/ No Style	vinyl siding	good	medium to low
106	1 South Policy Road (house with barn)	Salem	ca. 1870	Italianate	asbestos shingles	fair	medium
108	4 South Policy Road	Salem	ca. 1800	Federal	wood clapboards	good/ altered	medium

Table 3-23 Pre-1950 Potentially Historic Properties in Survey Area (Continued)

Property No.	Address	Community	Approx. Date	Style/Form	Materials	Condition	Integrity
107	2 South Policy Road (house and barn)	Salem	ca. 1860	Greek Revival/ Italianate	wood shingles	very good	high
108	4 South Policy Road	Salem	ca. 1800	Federal	wood clapboards	good/ altered	medium
109	9 South Policy Road	Salem	ca. 1870	Italianate/ No Style	vinyl siding	fair to good	low
110	130 South Policy Street	Salem	ca. 1900	No Style/ former cape	vinyl siding	good	low
111	132 South Policy Street	Salem	ca. 1910	Craftsman bungalow	asbestos shingles	fair	low
112	15 Trolley Lane	Salem	ca. 1900	Colonial Revival	vinyl siding	fair/ very altered	low
Subdivision							
113	3 MacFarland Road	Salem	ca. 1940	cape	vinyl siding	good/ altered	medium to low
114	4 MacFarland Road	Salem	ca. 1940	cape	vinyl siding	good	medium to low
115	5 MacFarland Road	Salem	ca. 1940	cape	vinyl siding	good	medium
116	6 MacFarland Road	Salem	ca. 1940	cape	wood shingles	fair to good	medium
117	7 MacFarland Road	Salem	ca. 1940	cape	vinyl siding	good	medium
118	MacGregor Avenue	Salem	ca. 1940	cape	wood shingles	fair to good	medium to high
119	MacGregor Road	Salem	ca. 1940	ranch	wood shingles	good	low
120	4 MacGregor Avenue	Salem	ca. 1900	Colonial Revival/ No Style	asbestos shingles	fair	medium
121	5 MacGregor Avenue	Salem	ca. 1940	cape	vinyl siding	good	medium to low
122	15 MacGregor Avenue	Salem	ca. 1940	cape	wood shingles	good	medium
123	22 MacGregor Avenue	Salem	ca. 1940	cape	wood shingles	fair to good	medium
124	24 MacGregor Avenue	Salem	ca. 1940	ranch	aluminum siding	good	medium to low
125	30 MacGregor Avenue	Salem	ca. 1940	cape	stone veneer	good	medium to low

Table 3-23 Pre-1950 Potentially Historic Properties in Survey Area (Continued)

Property No.	Address	Community	Approx. Date	Style/Form	Materials	Condition	Integrity
126	20 Maclarnon Road	Salem	ca. 1940	cape	wood shingles	good	medium
127	23 Maclarnon Road	Salem	ca. 1940	cape	vinyl siding	good	medium to low
128	24 Maclarnon Road	Salem	ca. 1940	ranch	vinyl siding	fair to good	low
129	25 Maclarnon Road	Salem	ca. 1940	cape	wood shingles	good	medium
130	26 Maclarnon Road	Salem	ca. 1940	cape	vinyl siding	good	medium
131	27 Maclarnon Road	Salem	ca. 1940	cape	wood shingles	good	medium
132	29 Maclarnon Road	Salem	ca. 1940	ranch	vinyl siding	good	medium
133	31 Maclarnon Road	Salem	ca. 1940	cape	vinyl siding	good	medium
134	32 Maclarnon Road	Salem	ca. 1940	ranch	vinyl siding	good	medium
135	33 Maclarnon Road	Salem	ca. 1940	cape	vinyl siding	good	medium
136	34 Maclarnon Road	Salem	ca. 1940	cape	vinyl siding	good	medium
137	35 Maclarnon Road	Salem	ca. 1940	cape	wood singles	good	medium
138	41 Maclarnon Road	Salem	ca. 1940	ranch	wood shingles	good	medium to high
139	144 South Policy Street	Salem	ca. 1940	ranch (addition with Queen Anne porch)	vinyl siding	good	medium
140	146 South Policy Street	Salem	ca. 1940	cape	vinyl siding	good	medium
141	147 South Policy Street	Salem	ca. 1940	cape	vinyl siding	good	medium
142	148 South Policy Street	Salem	ca. 1940	ranch	wood shingles	good	medium
143	149 South Policy Street	Salem	ca. 1940	ranch	vinyl siding	good	medium
144	150 South Policy Street	Salem	ca. 1940	cape	wood shingles	good	medium to high
145	152 South Policy Street	Salem	ca. 1940	cape	wood shingles	good	medium to high
146	155 South Policy Street	Salem	ca. 1940	cape	vinyl siding	good	low
147	157 South Policy Street	Salem	ca. 1940	cape	vinyl siding	good	medium to low
Exit 1							
148	2 Brady Avenue	Salem	early 20th century	cape	vinyl siding	good	medium
149	Salem Public Works	Salem	ca. 1870	Italianate	wood clapboards	fair/ altered	medium

Table 3-23 Pre-1950 Potentially Historic Properties in Survey Area (Continued)

Property No.	Address	Community	Approx. Date	Style/Form	Materials	Condition	Integrity
150	Cross Street	Salem	late 19th century	Victorian Eclectic	vinyl siding	very altered	low
151	25A Cross Street (converted barn)	Salem	1870/ converted to residence early 20th century	barn	asbestos shingles	fair to good	medium
152	25B Cross Street (behind former barn)	Salem	early 20th century	No Style	asbestos shingles	fair	low
153	6 Valeska Lane	Salem	ca. 1940	cape	wood shingles	good	medium
154	8 Valeska Lane	Salem	early 20th century	No Style	vinyl siding	good/ very altered	low
155	Valeska Lane	Salem	ca. 1930	Craftsman	vinyl siding	good/ very altered	low

3.17.3 Archaeological Resources

3.17.3.1 Prehistoric Resources

Prehistoric archaeological resources are those sites or remains that pre-date European settlement of the North American Continent. The I-93 Study Area is situated within the upper Merrimack River drainage. Archaeological investigations within the Merrimack River Valley have yielded a large number of important prehistoric sites spanning the Early Archaic (10,000-7500 B.P. [Before Present]) to the Late Woodland (1000-450 B.P.) periods. Background research indicates that six prehistoric archaeological sites were previously known or reported within, or immediately adjacent to, the I-93 Study Area (Bunker et al. 1990; Potter and Bunker 1991).

The Barlow Site (NH 45-135) is a Late Archaic (5000-3000 B.P.) Period site discovered by Raymond Barlow, an avocational archaeologist. The site is located on the east side of NH 111-A (Range Road) "just west of the I-93 southbound lanes" in Windham. Small stemmed projectile points and steatite, diagnostic of the Late Archaic, were recovered in a field between Canobie Lake and Cobbett's Pond.

The Dickey Plain Site II (NH 45-111-2) was surveyed by Victoria Bunker, archaeological consultant, during the 1990 intensive survey of the I-93 corridor from Salem to Manchester. The site is located in Manchester on a small terrace within the highway median strip between Interstates 93 and 293. Numerous flakes and tool fragments were recovered, along with projectile points diagnostic of the Late Archaic (Small Stemmed) and Transitional Archaic (Atlantic) periods.

The Dickey Plain Site III (NH 45-111-3) is located on a flat terrace on the north bank of Cohas Brook, between the southbound lane of I-93 and the southbound ramp from I-293 in Manchester. A total of 65 flakes, one biface base, one core, one edge tool fragment, and one biface fragment was found. A Carbon-14 (C-14) date within Late Archaic Period was recovered from the site. Due to the types of artifacts found, and the location of the site in close proximity to Cohas Brook, the Dickey Plain Site most likely functioned as a fishing station.

The Hayward Site (NH 45-124) was discovered during Bunker's initial survey of the I-93 median strip. It is located in Manchester between I-93 and I-293 in the vicinity of a small wetland. A Squibnocket projectile point datable to the Late Archaic Period was recovered along with four pieces of chipping debris, one base fragment, and one mid-section fragment. On the basis of these finds, the Hayward Site was probably a short-term campsite.

The Owens Site (NH 45-125) is located on a terrace overlooking Cohas Brook in Manchester, east of the I-293/I-93 underpass adjacent to the westbound lane of I-293. The site is described as having "two quartz cores, three volcanic flakes, two quartz flakes, and one quartzite flake". No diagnostic tools or features were found and therefore no specific site age can be given.

The Lovering Site (NH 45-126) was discovered during the 1990 intensive survey. The site is located adjacent to Cohas Brook in the median of I-93 in Manchester. A total of 26 flakes were recovered, along with fire cracked rock, possible evidence of a hearth. Although no diagnostic artifacts were found, the lithic materials recovered at the site correspond to other Late Archaic sites within the Merrimack River drainage.

As well as the prehistoric sites known or reported previously, an additional six potential prehistoric sites have been identified as a result of the investigations done as part of this I-93 study.

Site PH #21 is located about 125 feet (ft) from the east side of I-93 in Windham. It measures approximately 100 ft x 200 ft in size, and is situated on a gently sloping terrace. A total of five flakes (two quartz and three felsite) were recovered from the site. No diagnostic tools or features were found however to adequately date the site.

Site PH #22 is situated on a low-lying terrace adjacent to a re-routed stream just off the southbound lane of I-93 in Windham. A total of 88 pieces of quartz chipping debris was recovered within this site. Flake types found include: 86 unmodified flakes, one utilized flake, and one shatter. The high concentration of lithic debris in such a small area (two adjacent 50 x 50 cm test pits) suggests a possible tool reduction workshop. The site is not dateable due to the lack of diagnostic cultural materials and radiocarbon dates.

Site PH #35 is located on the west side of I-93 in Windham, about 175 ft from the highway. It is situated on a sloping terrace north of a small stream. No temporally diagnostic artifacts or features were found at this site. A total of seven flakes were recovered including five quartz, and two felsite.

Site PH #62 is located on the east side of I-93 and west of Cohas Brook in Manchester. Lithic materials recovered from the site include one quartz biface tool fragment, and two quartz flakes. PH #62 is considered a small "find spot" since additional testing around the area failed to recover additional cultural material.

Site PH #80 is situated adjacent to a small stream on the east side of I-93 in Manchester. A large amount of prehistoric chipping debris (50 pieces) was recovered at the site. Lithic materials include; quartz, quartzite, felsite, and rhyolite. In addition to the chipping debris, one Neville projectile point was found. On the basis of the diagnostic Neville point, this site can be dated to the Middle Archaic (7500-5000 B.P.) Period.

Site PH #87 is located east of a stream and south of a road on the east side of I-93 in Manchester. Quartz, felsite, argillite, and rhyolite flakes were recovered from the site. This site was also dated to the Middle Archaic Period due to the presence of a quartz Neville projectile point.

3.17.3.2 *Historic Resources*

Historic archaeological resources are those sites or resources dating from the time the North American Continent was settled by Europeans. The reconnaissance survey of the I-93 project corridor conducted by Bunker, Potter and Green (1990) identified 57 areas with sensitivity for the presence of historic cultural resources. The results of the initial survey are summarized in **Table 3-24**. Forty-three of historic sensitivity areas are transportation-related (transp), consisting of old roadways, railroad and/or trolley beds, bridge abutments, or stonewall alignments. Fourteen properties are Residential (res), agricultural (agr), or industrial (ind) archaeological sites or features (e.g. cellar holes, mill sites, etc.). During the intensive survey, PAL Inc. staff reviewed each of these areas and photo documented each resources.

In addition to the historic areas identified during the reconnaissance survey of the I-93 corridor (Bunker, Potter, and Green 1990), four historic features were identified during the intensive survey of the PH areas. These include: a stone lined well near PH #21; a stone dam near PH # 33; a 20th century trash dump near PH# 30; and a small foundation near PH# 30B. Each of these areas was investigated. Test units placed in the vicinity of each historic feature indicate that the areas do not appear to be significant.

Table 3-24 Historic Archaeological Sites

Description	Site Type*	Location	Town	Date	Owner/ Occupant	Conditions	Subsurface Testing
Double Arch Stone Bridge	Transp	Harris Brook	Salem				None
Trolley Bed remains	Transp	N side Main St.	Salem				None
Stone Bridge Abutments	Transp	E side I-93	Salem				None
Quarry Site	Ind		Salem				None
Trolley Bed remains	Transp		Salem				None
Taylor Grist Mill Site	Ind	Policy Brook	Salem			Disturbed	None
Trolley Bed remains	Transp		Salem			Paved	None
Cellar hole	Res/Agr	W side I-93	Salem				None
Old Roadway (I-93 crossover)	Transp		Windham				None
Old Rt 111A	Transp		Windham				None
Searle Estate stone wall	Res/Agr		Windham		Searle School & Estate		None
Cellar Hole	Res/Agr		Windham				None
Searle Estate stone wall	Res/Agr		Windham				None
Collapsed Structure	Res/Agr	County & Indian Rock Roads	Windham	Late 19 th c.	1892-W.A Dinsmore.		

* Site Type:

Transp = Transportation

Ind = Industrial

Res/Agr = Residential/Agricultural

Table 3-24 Historic Archaeological Sites (Continued)

Description	Site Type	Location	Town	Date	Owner/ Occupant	Conditions	Subsurface Testing
Old County Road	Transp	W side I-93	Windham				None
Stone Bridge Abutments	Transp	Indian Rock Rd.	Windham			Borrow pit	
Old County Rd.	Transp	W side I-93	Windham				None
Gov. Dinsmore Rd.	Transp		Windham				None
Carriage House Foundation	Res/Agr		Windham		Dinsmore	Brentwood	None
Old County Road	Transp		Windham				None
Old County Road	Transp		Windham				None
Stone dump	Ind		Windham				
Old County Rd.	Transp		Windham				None
Old County Rd	Transp		Windham				None
Old County Rd	Transp		Windham				None
Old County Rd	Transp		Windham				None
Old Roadway	Transp						None
Old Rail Bed	Transp	W side I-93	Windham	1892			None

Table 3-24 Historic Archaeological Sites (Continued)

Description	Site Type	Location	Town	Date	Owner/ Occupant	Conditions	Subsurface Testing
Old Rail Bed	Transp	W side of I-93	Windham	1892			None
Abandoned Rail Bed	Transp		Derry	mid 1800s	B&M RR		None
Abandoned Rail Bed	Transp		Derry	mid 1800s	B&M RR		None
Abandoned Rail Bed	Transp		Derry	mid 1800s	B&M RR		None
Old Roadway	Transp		Derry				None
Old Roadway w/stone walls	Transp		Derry				None
Old Roadway	Transp		Derry				None
Old Roadway	Transp	SE of Kendall Pond Road	Derry		Not on maps		None
Old Reo St.	Transp	E of I-93	Londonderry				None
Trolley Track Bed	Transp		Londonderry			paved	None
Old Pillsbury Rd.	Transp	W of I-93	Londonderry				None
Cellar hole w/ assoc. barn Foundation	Res/Agr	E&W of Old Rd.	Londonderry		Not on maps	Backyard	None
Cellar hole	Res/Agr	W side of I-93	Londonderry				None
Old Pillsbury Rd.	Transp	E side of I-93	Londonderry				None
Old Rail Bed	Transp	W side of I-93	Londonderry	1892			None

Table 3-24 Historic Archaeological Sites (Continued)

Description	Site Type	Location	Town	Date	Owner/ Occupant	Conditions	Subsurface Testing
Old Pillsbury Rd.	Transp	E side of I-93	Londonderry				
Collapsed Structure	Res/Agr	E side of I-93	Londonderry				None
Old Roadway	Transp	E side of I-93	Londonderry				None
Old Roadway	Transp		Londonderry				None
Old Roadway	Transp		Londonderry				None
Old Roadway	Transp		Londonderry				None
Old Roadway	Transp		Londonderry				None
Stonewall Enclosure	Agr		Londonderry				None
Railroad Bed	Transp		Londonderry	mid 19 th c.	B&M RR	Abandoned	None
Railroad Bed	Transp		Londonderry	mid 19 th c.	B&M RR	Abandoned	None
Railroad Bed	Transp		Londonderry	mid 19 th c.	B&M RR	Abandoned	None
Stonewall Enclosure	Agr	Powerline ROW	Londonderry				None
Old Roadway	Transp	E side of I-93	Londonderry				None
Remains of Brickett Rd.	Transp	I-93 median	Manchester				None

3.18 Potential Hazardous Materials Sites

Two major concerns relate to hazardous materials and hazardous wastes, in connection with highway construction. The primary issue involves the liability the State may take on should it acquire sites that have been affected by hazardous waste releases. The secondary concern deals with the handling of hazardous materials encountered during construction.

If the Selected Alternative involves a site containing hazardous wastes, the site owners would be subject to federal and state regulations governing the cleanup and disposal of the material and be liable for the cost of remedial actions. If the State acquires a property requiring remedial action, it may also acquire some financial liability for these actions. In addition, the presence of hazardous wastes in a construction zone might require additional planning and expenses in order to minimize the construction workers' exposure to hazardous wastes.

Examples of hazardous materials that may be encountered during construction activities include gasoline constituents (benzene, toluene, ethyl benzene, xylenes, and methyl-tertiary-butyl-ether), chlorinated solvents associated with parts cleaning at gasoline stations, manufacturing facilities, and dry cleaning, and polycyclic aromatic hydrocarbons (PAHs) associated with creosote-covered railroad ties, asphalt, or the combustion of petroleum-related products.

Federal laws regarding the generation and disposal of potentially hazardous materials include, but are not limited to, the following:

Clean Water Act (CWA) 40 CFR Parts 100-149

Regulates the discharge of hazardous pollutants into the nation's surface waters.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) 40 CFR Parts 300-399

Comprises a program to identify, investigate, and remediate uncontrolled hazardous waste sites.

Resource Conservation and Recovery Act (RCRA) 40 CFR Parts 190-299

Regulates hazardous waste generation, storage, transportation, treatment and disposal.

Toxic Substance Control Act (TSCA) 40 CFR Parts 700-End

Regulates the manufacture, use and disposal of chemical substances.

Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) 40 CFR Parts 150-189

Protects water resources by placing controls on the use of certain pesticides and prohibiting the use of others.

CERCLA and/or RCRA are likely to apply to the project if hazardous wastes are encountered prior to, or during, construction. Provisions of the CWA may also apply to site clean-ups, as may provisions of the US Department of Transportation regulations governing the transport of hazardous materials.

The Water Supply and Pollution Control Division and the Waste Management Division of the NHDES are charged with the oversight of projects involving the generation, storage, transportation, and disposal of hazardous materials. The state laws and regulations governing hazardous and solid waste include:

RSA 149:8 (Ws 410) Groundwater Quality Discharge Permit

Establishes criteria for the issuance of permits to discharge or dispose of waste which may substantially affect the groundwaters of the state.

RSA 149:4 (Ws 403.02 & 403.03) NPDES Permits

Provides for state administration of National Pollution Elimination Discharge System (NPDES) permits, governing the amount and characteristics of wastes discharged to surface waters.

RSA 146-A:11c (Ws 411) Underground Storage Tank Permit

Requires testing of underground storage tanks and regulates their usage.

RSA 149-M:10-11 (He-P 1901.04) Solid Waste Regulations

Regulates the siting, operation, and closure of solid waste facilities.

RSA 147-A:4-5 (He-P 1905.09) Hazardous Waste Regulations

Establishes standards and regulates permitting of hazardous waste operations in the state.

The generation and disposal of non-hazardous waste by the project would have to comply with the state's solid waste regulations, and the remediation of any hazardous waste site would require approval under the state's hazardous waste regulations. Transport of wastes would have to comply with the NH Department of Safety regulations.

During identification of the Preferred Alternative, a review of the properties within the corridor will be necessary to determine whether known hazardous waste sites are crossed

or whether other sites have potential hazardous waste releases, and to determine responsibility for dealing with these releases under the regulatory framework described above.

3.18.1 Summary of Findings

Several sources of existing information have been used to compile a listing of hazardous waste sites and sites with hazardous material generators within or close to the I-93 corridor (**Figure 3-12**). Sources of information include the following:

- Department of Environmental Services, Waste Management Division, list of "CERCLIS Sites" (March 26, 1992);
- Department of Environmental Services, Waste Management Division, list of hazardous waste generators (September 18, 1992); and
- Department of Environmental Services, Groundwater Protection Bureau, listing of sites (July 2, 1992).

Data from these lists are summarized in **Table 3-25** through **Table 3-28**. The locations of the properties identified in these tables are shown on **Figure 3-12**.

During identification of the Preferred Alternative, these lists will be used to determine whether known hazardous waste sites are situated within or adjacent to the proposed right-of-way, and a further analysis of the project's potential impacts will be made.

Insert Figure

3-12 Potential Environmental Risk Sites

(Sheet 1 of 2)

Insert Figure

3-12 Potential Environmental Risk Sites

(Sheet 2 Of 2)

Table 3-25
Key to Abbreviations used in Tables 3-26, 3-27 and 3-28

CERCLA	Superfund Site
H2O Sample	Water Sample
HAZ/Non-GW	Hazardous/Non-Groundwater
HAZWSTE/GP	Hazardous Waste/Groundwater Pollution
HAZWSTE/WM	Hazardous Waste/Waste Management
Hold Tank	Holding Tank
LAND/UNLN	Unlined Landfill
LUST	Leaking Underground Storage Tank
ODD	Oil Discharge and Disposal/Cleanup Fund Site
Septic	Septic System
Site Eval.	Site Evaluation
SLUD/LAG	Sludge Lagoon
Spill/RLS	Spill/Release
SPRAYIRR	Spray Irrigation System
Stump/Demo	Stump and Demolition Debris Disposal
Trans. Sta.	Transfer Station
UIC	Underground Injection Control
UWW/LAG	Untreated Wastewater Lagoon

Table 3-26
New Hampshire Department of Environmental Services
Waste Management Division
“CERCLIS” Sites Within I-93 Corridor*

Map Ref.				
<u>City/Town</u>	<u>Site No.</u>	<u>Type of Site</u>	<u>Project Type</u>	<u>No. **</u>
Derry	8706012	Municipal Landfill	HAZWSTE/WM	33
Salem	840524	Landfill/Auto Parts	HAZWSTE/WM	7
Salem	840533	Wastewater Facility	HAZWSTE/WM	1

* From list generated from 1999 All Sites List, NHDES.

** See **Figure 3-12**

Table 3-27
NHDES Waste Management Division
List of RCRA Generators Within I-93 Corridor*

<u>Map Ref.</u> <u>City/Town</u>	<u>Facility ID No.</u>	<u>Type of Site</u>	<u>Activity Type**</u>	<u>No.***</u>
Derry	NHD981070972	Public Works	SG	33
Derry	NHD981884240	Garage	SG	41
Derry	NHD043160605	Garage	SG	NM
Derry	NHD000846626	Service Station	SG	42
Londonderry	NHD98648395	Bottling Facility	SG	63
Londonderry	NHD981894090	Equipment Rental	SG	NM
Londonderry	NHD012040275	Service Station	SG	40
Londonderry	NHD982198475	Waste Disposal/Recycling	SG	53
Londonderry	NHD982749970	Printing Facility	SG	45
Londonderry	NHD982202509	Auto Repair	SG	44
Londonderry	NHD981203284	Motor Bike Repair	SG	NM
Londonderry	NHD081250367	Well Company	SG	51
Londonderry	NHD986481877	Gasoline Station	SG	39
Londonderry	NHD980523559	Telephone Company	SG	NM
Londonderry	NHD986474211	Automobile radiator repairs	VG	43
Londonderry	NHD986471076	Landfill	SG, *LG	56
Londonderry	NHD986485803	Department Store	SG	48
Londonderry	NHD982193062	Car Care	SG	50
Londonderry	NHD043160605	Auto Repair	SG	47
Manchester	NHD052017787	Electronic Manufacturing	VG	59
Salem	NHD986474351	Pharmaceutical Mfg/Sales	VG	20
Salem	NHD986468676	Plating/Manufacturers	VG	10
Salem	NHD980525646	Manufacturing	SG	35
Salem	NHD981071459	telephone Company	SG	3
Salem	NHD982749475	Auto Repairs.	SG	NM
Salem	NHD986472728	Testing Laboratory.	SG	21
Salem	NHD986474377	Electronic Equipment Sales/Mfg		11
Salem	NHD039129440	Computer Mfg	SG	25

Table 3-27
(continued)
NHDES Waste Management Division
List of RCRA Generators Within I-93 Corridor*

<u>Map Ref.</u> <u>City/Town</u>	<u>Facility ID No.</u>	<u>Type of Site</u>	<u>Activity Type**</u>	<u>No.***</u>
Salem	NHD039129440	Welding/Machine Shop	VG	25
Salem	NHD073976904	Coated Plastics Mfg	LG	26
Salem	NHD500003553	DPW	SG	4
Salem	NHD980523732	Electronic Mfg.	SG	15
Salem	NHD120550967	Electric Company	SG	60
Salem	NHD981214315	Printed and Etched Circuit Mfg	VG	23
Salem	NHD980668156	Printed and Etched Circuit Mfg	LG	22
Salem	NHD986473122	Mfg. Facility	VG	22
Salem	NHD001048925	Manufacturing Facility	SG	16
Salem	NHD986468882	Computer Peripheral Mfg.	SG	61
Salem	NHD982747347	Auto Repair	SG	19
Salem	NHD982200982	Electronic Connector Mfg.	SG	NM
Salem	NHD053469169	Manufacturing Facility	SG	NM
Salem	NHD980525430	Fiberglass Fabricators.	SG	16
Salem	NHD986471779	Printers	VG	61
Salem	NHD986466878	Auto Sales	SG	NM
Salem	NHD986470193	Glass/Sheetmetal Fabricators	SG	24
Salem	NHD095513602	Bus Yard	SG	8
Windham	NHD000845636	Gasoline Station	VG	29

* From list generated from 1999 All Sites List, NHDES

** Activity Types:

LG = Large Quantity Generator (more than 1000 Kg/month)

*LG = Large Quantity Generator of State-Only Waste

SG = Small Quantity Generator (100-1000 Kg/month)

VG = Very Small Generator (less than 100Kg/month)

NM = Not Mapped (within the Study Area but exact location unknown)

*** See **Figure 3-12**

Table 3-28
Groundwater Protection Bureau
List of Sites within I-93 Corridor*

Map Ref. <u>City/Town</u>	<u>Site No.</u>	<u>Type of Site</u>	<u>Project Type</u>	<u>No.**</u>
Derry	840135	WWTP	UWW/LAG	37
Derry	840136	Well Field (DPW)	LUST	33
Derry	870601	Landfill	Land/UNLN	33
Derry	871220	Solid Waste Tran. Station	Trans. Station	36
Derry	920620	Residence	Spill/RLS	34
Londonderry	840329	Printing Facility	UIC	45
Londonderry	890758	Truck Equipment Wholesale	Hold Tank	54
Londonderry	900817	Gasoline Station	LUST	40
Londonderry	910217	Gasoline Station	LUST	39
Londonderry	920328	Fuel Spill Site	Complaints	57
Manchester	880520	Farm	Septic	NM
Salem	840522	Printed and Etched Circuit Board Mtg.	HAZWSTE/GP	23
Salem	840523	Laboratory	Site Eval.	18
Salem	840524	Landfill/Auto Parts	LAND/UNLN	7
Salem	840527	Industrial Park	HAZWSTE/GP	27
Salem	840533	Wastewater Facility	HAZWSTE/WM	1
Salem	871007	Professional Park Property	SEPT/LAG	17
			HAZWSTE/WM	17
Salem	880111	Coated Plastic Mfg.	Site Eval.	26
Salem	911003	Property	Site Eval.	5
Salem	9209021	Computer Mfg.	GPB/RCRA/UST	25
Salem	9509022	Shopping Center	LUST	9
Salem	9003010	DPW	LUST	4
Salem	9311018	Bus Yard	LUST	8

Table 3-28
(continued)
Groundwater Protection Bureau
List of Sites Within I-93 Corridor*

Map Ref. <u>City/Town</u>	<u>Site No.</u>	<u>Type of Site</u>	<u>Project Type</u>	<u>No.**</u>
Windham	880838	Hazardous Waste	HAZWSTE/WM	28
Windham	981048	Gasoline Station	ODD	29
Windham	900731	Unlined Wastewater Lagoon	SPRAYIRR	32
Windham	900801	Leaking Underground Storage Tank	LUST	30
Windham	920509	Gasoline Station	LUST	31

- From list generated from 1999 All Sites List, NHDES
- ** See **Figure 3-12**

3.19 Transportation

This section summarizes existing traffic conditions, levels of service, and infrastructure conditions and needs of I-93 and its interchanges between the state line in Salem to the I-93/I-293 split in Manchester. The data collection effort includes origin-destination surveys, travel time and delay surveys, vehicle occupancy counts, vehicle classification counts, and weekday AM and PM peak hour traffic volume counts. In addition crash statistics based on state and local police reports have been evaluated and summarized.

The Traffic Volumes Section (3.19.2) summarizes existing traffic volume trends, the development of appropriate design hour volumes, the results of the existing traffic operations evaluation, and, describes the traffic-forecasting model.

The infrastructure conditions and needs assessment includes a discussion of the existing highway facility layout and identifies geometric deficiencies along the corridor. This assessment also includes a description of pavement conditions and a summary of bridge conditions within the study area.

3.19.1 Traffic Data Collection

Because of the regional nature of the service I-93 provides, data collection efforts were concentrated both within and outside the study corridor. Due to the size and scope of the study of I-93 between Manchester and Salem, New Hampshire, an extensive data collection program was required. This information is crucial to determine existing travel patterns, characteristics, and facility level of service. The data collection program consisted of the following components:

- Origin - Destination Survey
- Travel Time and Delay Survey
- Vehicle Occupancy Counts
- Compilation of Traffic Volume and Vehicle Classification Counts

Details of each component are discussed briefly below. Traffic volumes and vehicle classification counts were supplied by the New Hampshire Department of Transportation (NHDOT).

3.19.1.1 *Origin - Destination Survey*

An origin-destination survey of motorists was conducted, along I-93, and at locations which parallel or feed I-93 during June and July, 1992. Fourteen locations were covered by a postcard survey, where motorists were momentarily stopped and given a questionnaire on travel patterns. They were asked to answer and return cards in the mail at no cost to the respondent. Cards were distributed at the following locations, on the following dates:

- I-93 - Exit 1 - June 15, 1992
- I-93 - Exit 2 - June 16, 1992
- I-93 - Exit 3 - June 17, 1992
- I-93 - Exit 4 - June 18, 1992 - Two Locations
- I-93 - Exit 5 - June 19, 1992
- I-93 - Exit 8 - June 22, 1992
- I-93 - Exit 9 - June 23, 1992
- I-93 - Exit 10 - June 24, 1992
- I-293 - Exit 2 - June 26, 1992
- I-293 - Exit 1 - June 29, 1992
- Rte 101/114 - June 30, 1992
- NH 28 - July 1, 1992
- Hooksett Toll - July 2, 1992

All survey stations were operated between the hours of 6:00 - 10:00 AM. Survey stations on I-93 were positioned on southbound on-ramps. The southbound on-ramps were surveyed during this time period because the southbound flow is representative of the peak commuter characteristics.

The stations on I-293 were located on eastbound on-ramps. The station on NH 28 was operated on the southbound lane, immediately south of the NH 28/NH 111 intersection. The NH 101/NH 114 station was located on NH 101, just east of the signalized intersection. Cards were distributed at the Hooksett Toll Booth on I-93 at the automatic gates, in the southbound direction. Because most of the drivers surveyed during the origin - destination program were traveling from home to work, a basic premise in this study (for modeling purposes) is that a similar pattern of trips headed southbound during the AM peak period will be traveling northbound during the PM period.

A total of 18,090 survey questionnaires were distributed at the locations listed above. An overall response rate of 39.2% (7,090 cards) was realized, which was considerably higher than the target return rate of 25%. The location with the highest return percentage was the Hooksett Toll Booth (46.0%). The eastbound on-ramps at Exit 2 on I-293 (Brown

Avenue) had the lowest return rate (27.3%). Generally, entrances closer to the Massachusetts border had a higher return rate; for example, return rates at on-ramps at Exits 1,2, and 3 were higher than the overall survey average.

Detailed characteristics of the drivers in the I-93 corridor were drawn from the responses. Questions relating to travel frequency, trip purpose, vehicle occupancy, and potential mass transit ridership were asked. The results of the origin-destination responses are briefly discussed below. Of those total individuals who returned survey questionnaires on the I-93 and I-293 ramps, 66% were ending their trip in Massachusetts, while only 29% of the destinations were in New Hampshire. Further, during peak travel times, I-93 is primarily used as a commuting facility between home and work, in single occupant vehicles, five or more times per week.

Frequency of Travel

A total of 76% of the drivers responded that the trip they were taking at the time they received the questionnaire occurred five or more times per week. In contrast, only 9% of the respondents replied that the trip occurred less than one time per week, and 9% replied that the trip was taken one to two times per week.

Carpool/Vanpool Use

Drivers were asked whether or not the trip they were taking at the time that they received the card was part of a carpool or vanpool; 97% responded in the negative. Of those whose trip was part of a carpool or vanpool, 69% were part of a daily carpool/vanpool, while 31% used this form of travel only occasionally.

Trip Purpose

During peak travel hours, I-93 is primarily used as a commuting facility between home and work. At the time they received the survey card, a total of 92% of the respondents had started their respective trips from home and a total of 86% were traveling to work. Less than 1% of the total responses stated that they were traveling to a mass transit terminus: carpool lot, bus stop, or train station.

Preferred Mass Transit

Drivers were given a list of potential mass transit options and asked which they would likely use, if they were made available to them. 60.1% responded that they would not use mass transit, 25.4% would ride a train, 14.4% would likely use a bus, and 8.6% would arrange travel on highway lanes developed for high occupancy vehicles (HOV).

Vehicle Occupancy

The majority of respondents indicated that they made their respective trips alone - 82% traveled alone, while 13% of the trips included one passenger, and only 5% of the vehicles carried more than one passenger.

3.19.1.2 Travel Time and Delay Study

A travel time and delay study was conducted along the I-93 corridor during the months of July and August, 1992. The travel time runs were conducted during the weekday morning (6:00 – 9:00 AM) and weekday evening (4:00 – 7:00 PM) peak travel periods. For the purpose of the travel time and delay study, the study corridor extended along I-93 from the I-293 split in Manchester to Route 110 (Exit 46) in Massachusetts. Travel runs were conducted in both the northbound and southbound directions.

Given the substantial increase in the volume of traffic that has been recorded along the corridor in recent years, it is expected that the travel time and delay experienced by motorists has changed substantially since 1992. Therefore, to supplement the 1992 data, additional travel time runs were conducted during the months of March and April, 2000. Recognizing the importance of evaluating the corridor on a regional level, the updated travel time study included travel runs as far south as South Station in Boston, Massachusetts.

Checkpoints consisting primarily of interchanges were established along the corridor and travel times between each checkpoint were recorded. From this information, average travel speeds between checkpoints, as well as total travel time for the corridor was computed.

The results of the 1992 travel time runs (between I-293 and Route 110 in Massachusetts) revealed no stop-and-go traffic. However, specific segments of the corridor consistently experienced relatively slower travel speeds. Specifically, the segment between Exit 1 in New Hampshire and Exit 48 in Massachusetts recorded somewhat slower travel speeds. In the northbound direction, average travel speeds were recorded at 60 miles per hour (mph) during the AM and 59 mph during the PM. In the southbound direction, average travel speeds were recorded during the AM and PM peak periods at 48 mph and 59 mph, respectively. Segments north of Exit 1 operated at free flow.

In contrast, the results of the recent travel time runs revealed substantially more delay. During the AM peak period in the southbound direction, average travel speeds were recorded as follows:

2000 AM Peak Southbound	
<u>Segment</u>	<u>Average Speed</u>
I-293 to Exit 5	60-70 mph
Exit 5 to Exit 4	50 mph
Exit 4 to Exit 3	70 mph
Exit 3 to State line	40-50 mph
State line to Exit 47 (Pelham Street)	35-45 mph
Exit 47 to Exit 45 (River Road)	50-55 mph
Exit 45 to Exit 37 (Route 128)	30-40 mph

As shown, during the morning peak period in the southbound direction, motorists travel close to free flow from I-293 to Exit 5. However, travel speeds slow to 50 mph between Exits 5 and 4, while increasing again to close to free flow conditions (70 mph) between Exit 4 and Exit 3. Substantial reductions in travel speed were recorded south of Exit 3, with motorists traveling 50 mph or less between Exit 3 and the state line. Travel speeds in Massachusetts between the state line and Exit 47, and between Exit 45 and Exit 37 were recorded at between 35-45 mph and 30-40 mph, respectively.

During the PM peak period in the northbound direction, the recent travel time runs revealed the following average travel speeds:

2000 PM Peak Northbound	
<u>Segment</u>	<u>Average Speed</u>
Exit 37 (Route 128) to Exit 45	45-65 mph
Exit 45 (River Road) to Exit 47	35-50 mph
Exit 47 (Pelham Street) to State line	20 mph
State line to Exit 2	20-40 mph
Exit 2 to Exit 3	55 mph
Exit 3 to I-293	60-65 mph

As shown, during the evening peak period in the northbound direction, travel speeds in Massachusetts between Exit 37 and Exit 45 vary from 45-65 mph. Substantial and sustained congestion begins to build at Exit 45 as travel speeds slow to 35 to 50 mph to Exit 47. Motorists experience substantial delay between Exit 47 and the state line with average travel speeds reduced to 20 mph. Substantial delay continues to be experienced between the state line and Exit 2 with average travel speeds ranging from 20-40 mph. The level of congestion begins to diminish north of Exit 2 as average travel speeds were recorded at 55 mph between Exit 2 and Exit 3. Average travel speeds were recorded at 60-65 mph between Exit 3 and I-293.

In summary, the results of the travel time and delay study reveal that under existing conditions, motorists experience substantial delay along the I-93 corridor during the weekday AM and PM peak commuter periods. This level of congestion is striking in comparison to the travel times recorded in 1992 (8 years ago), which showed relatively free flow with only moderate slow downs south of the state line.

3.19.1.3 Vehicle Occupancy Counts

Vehicle occupancy patterns in the study area are a measure of potential high occupancy vehicle (HOV) lane usage. In addition to the occupancy data collected during the origin - destination survey, occupancy counts were collected during the months of August and September, 1992 along I-93, the F.E. Everett Turnpike, and NH 28. Occupancy data were collected for the weekday AM (6:00 - 9:00 AM), the midday (11:00 AM - 1:00 PM), and the PM (4:00 - 7:00 PM) peak periods. To remain consistent with the traffic patterns derived from the origin-destination survey, all occupancy counts were performed on southbound traffic.

Two locations each on I-93, the F.E. Everett Turnpike, and NH 28 were included in the occupancy counts. On I-93, occupancy results of the origin-destination survey were substituted for the AM occupancy counts. Midday and evening occupancy counts were collected on this facility. On NH 28, origin-destination results were substituted for one location during the AM peak period. To complete the required counts on NH 28, midday and evening occupancy counts were performed at the same location as the origin-destination survey, and one additional location was counted during all peak periods. The data is summarized in Table 3-29.

TABLE 3-29
VEHICLE OCCUPANCY SUMMARY

Location	1 occupant per vehicle		2 occupants per vehicle		3 to 4 occupants per vehicle		5 occupants per vehicle		6 or more occupants per vehicle		Total
	(veh)	(percent)	(veh)	(percent)	(veh)	(percent)	(veh)	(percent)	(veh)	(percent)	(veh)
I-93 Exit 1	530	77%	104	15%	48	7%	2	0%	5	1%	689
I-93 Exit 2	387	77%	81	16%	30	6%	2	0%	1	0%	501
I-93 Exit 3	531	79%	96	14%	46	7%	0	0%	1	0%	674
I-93 Exit 4	993	75%	221	17%	88	7%	15	1%	8	1%	1,325
I-93 Exit 5	210	79%	40	15%	14	5%	1	0%	0	0%	265
FEE Trnpke – Nashua	5,949	87%	773	11%	60	1%	8	0%	10	0%	6,800
FEE Trnpke – Bedford	2,888	90%	270	8%	32	1%	3	0%	4	0%	3,197
NH 28 – Windham	452	75%	89	15%	58	10%	2	0%	5	1%	606
NH 28 – Salem	968	80%	176	15%	49	4%	8	1%	4	0%	1,205

The results of the vehicle occupancy survey showed that between 75 and 79 percent of motorists traveling along the I-93 corridor were single occupant vehicles. Interestingly, an even higher percentage (87% - 90%) of vehicles traveling the F.E. Everett Turnpike were single occupant vehicles.

3.19.1.4 Vehicle Classification

The classification of vehicles by type (i.e. passenger car, single unit truck, tractor-trailer, bus) is an important part of the data collection program, specifically for use in air quality and noise studies along the study corridor. Vehicle classification counts have been performed periodically in various locations along I-93 within the Study Area as required to address specific project needs. Counts performed in the late 1980's/early 1990's indicated that truck traffic made up approximately 7.5% of the total traffic volume. Clarification counts performed in 1997 between Exits 3 and 4 indicated that truck volumes were running about 10% of total traffic. Counts in 1999 between Exits 1 and 2 showed the truck percentage to be 9.5%. In summary, the data indicates that while percentage of truck traffic is increasing to some degree, I-93 remains largely a commuting facility with passenger vehicles making up a vast majority of the vehicles along the corridor.

3.19.2 Traffic Volumes

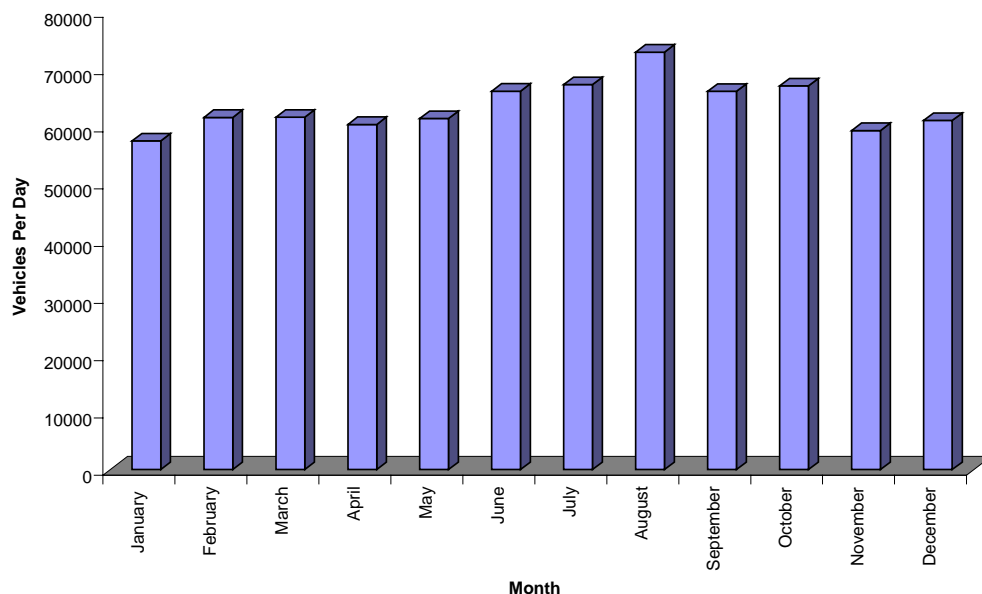
The purpose of this section is to establish and evaluate the existing traffic conditions along the study corridor. The section includes a discussion on traffic volume trends, the development of an appropriate design hour volume condition, and the results of the existing conditions traffic operations evaluation.

Traffic Volume Trends

The NHDOT maintains two (2) automatic traffic volume recorder stations (24 hour operation) along I-93 within the study area – Station 399001/399002 in Salem, just south of Rockingham Boulevard, and Station 489003/489004 in Windham, north of Exit 3. To supplement these counts, the NHDOT conducted 1997 weekday AM and PM peak period traffic counts at each interchange (Exit 1 through Exit 5) area. These peak hour volumes were seasonally adjusted to reflect an annualized average weekday condition based on review of monthly traffic volume variations at the Salem and Windham control counting stations. Peak hour traffic volumes are approximately nine percent of daily volumes, and reflect the commuter orientation of the corridor where approximately 60 percent of the traffic flow is southbound in the AM peak hour, and northbound in the PM peak hour.

Examination of the monthly variation in average daily traffic (ADT) along I-93 show August with an ADT of 73,000 vehicles per day (vpd) as the peak month. Despite the

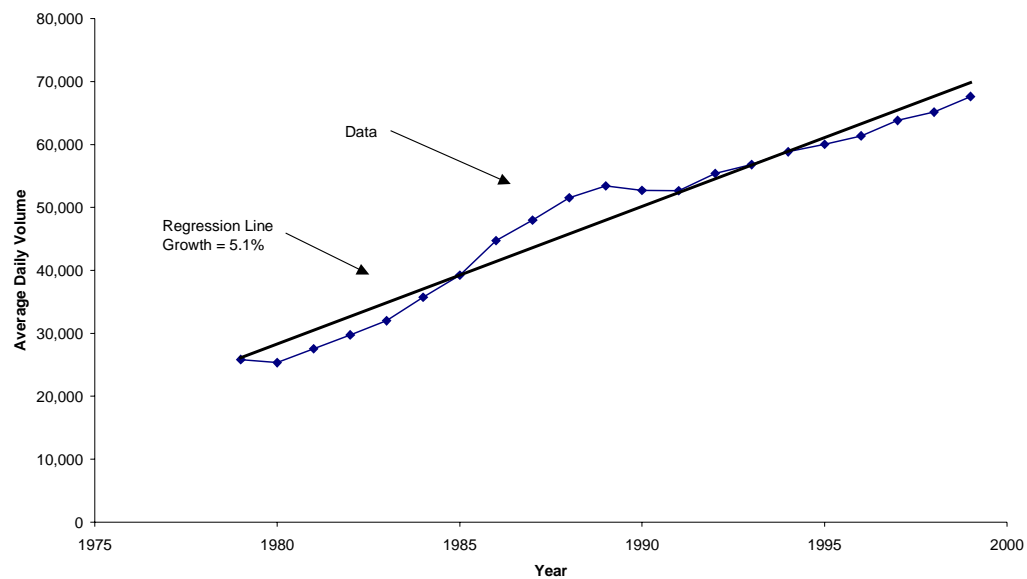
Figure 3-13
Monthly Variations
I-93 At Fordway Bridge In Derry
Average Daily (1997)



influence of ski activity during the winter months, the volume of traffic on a daily basis is somewhat higher during the summer recreational months of June, July, August and September. October volumes (67,000 vpd) reflect foliage season. The monthly variations are shown graphically in **Figure 3-13**.

In addition to reviewing seasonal trends, historical traffic growth trends were also examined. The NHDOT permanent traffic recorder count station located between Exits 3 and 4 provided historical traffic volume data for the past 20 years. The growth in ADT is depicted in **Figure 3-14**. The ADT over the 20-year period revealed an average annual growth rate of 5.1 percent. The most substantial growth occurred during the 1980's with the rate of increase slowing during the 1990's.

Figure 3-14
Windham (Exits 3-4) Derry Town Line
Average Annual Traffic Growth



The general unit of measure used to quantify roadway usage is the average daily traffic (ADT), which is defined as the total volume of traffic during a given period of time divided by the number of days in that time period. A more specific unit of measure is known as the average annual daily traffic volume (AADT), which is determined by dividing the total yearly volume by the number of days in the year. Although an actual AADT can only be established at a continuous count station, AADT's can be estimated along segments of roadways by applying adjustment factors developed from data collected at continuous count stations to specific daily or hourly counts.

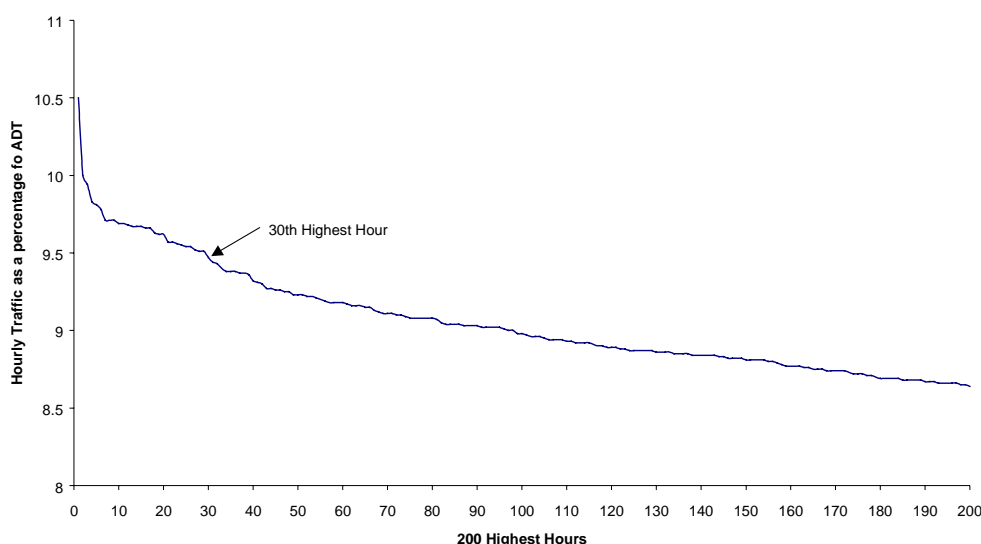
While the AADTs are an important measure, it is the hourly volume condition that is primarily used to evaluate and design roadway facilities. However, because hourly traffic volumes can vary substantially over the course of a day and throughout the year, it is necessary to select an appropriate design hourly volume condition. It would be wasteful to predicate a design on the (maximum) peak hour traffic of the year, yet the use of the average hourly traffic would result in an inadequate design. The hourly traffic volume used for the purpose of design should not be exceeded very often or by very much. On the other hand, it should not be so high that the volume of traffic would rarely be high enough to make full use of the facility.

The procedure used to evaluate both existing and future traffic volume demands on a roadway system, as described in *A Policy on Geometric Design of Highways and Streets*⁵, is to establish a 30th highest hour volume (design condition). Given the

⁵ American Association of State Highway and Transportation Officials, *A Policy on Geometric Design of Highways and Streets*, Washington, D.C.

economic considerations involved in the planning and design of roadway facilities, this design criteria is selected since the 30th highest hourly volume generally reflects a “point of diminishing return” in that a substantial increase in design requirements would accommodate only very few periods of higher traffic volumes. This condition is reflected in the curve, as shown in **Figure 3-15**, which tends to steepen quickly to the left of the 30th highest hour indicating much higher volumes for the inclusion of only a few more of the higher hourly volumes while the curve flattens to the right indicating many hours in which the volume is not much lower than the 30th highest hour.

Figure 3-15
Peak Hour to ADT Relationship
I-93 At Fordway Bridge In Derry (1997)



Based on the data provided at the NHDOT permanent count station, the 30th highest hour volume is approximately 9.4 percent of the ADT. The Directional Design Hour Volume (DDHV) split shows approximately 60 percent of the total hourly traffic traveling in the peak direction.

As shown in **Table 3-30**, the 1997 ADT along the corridor ranges from a low of approximately 61,800 vehicles per day (vpd) between Exits 3 and 4 to a high of approximately 104,400 vpd south of Exit 1. The DHV ranges from approximately 5,800 vehicles per hour (vph) to 9,800 vph. Similarly, the DDHV ranges from approximately 3,500 vph to approximately 5,900 vph.

Table 3-30
1997 Base Year Traffic Volumes****

Segment	ADT*	DHV**	DDHV***
North of Exit 5	69,300	6,500	3,900
Between Exits 4 and 5	64,900	6,100	3,700
Between Exits 3 and 4	61,800	5,800	3,500
Between Exits 2 and 3	74,900	7,000	4,200
Between Exits 1 and 2	81,100	7,600	4,600
South of Exit 1	104,400	9,800	5,900

*ADT - Average Daily Traffic

** DHV - Design Hour Volume (9% of ADT)

***DDHV - Directional Design Hour Volume (60% of DHV)

**** - All Volumes are based on I-93 Subarea Traffic Model (see Traffic Forecasting Section)

The 1997 weekday morning and evening peak hour traffic volumes at each of the study corridor intersections are presented in **Figures 3-16 and 3-17**.

Existing Traffic Operations

Measuring the volume of traffic along the I-93 corridor indicates the importance of the corridor to the regional transportation system but gives little indication of the quality of traffic flow. To assess the quality of traffic flow along the corridor and other study area roadways, capacity analyses were conducted to determine how well the I-93 corridor serves the traffic demands placed upon it. The traffic performance measures and the evaluation criteria used in the operational analyses are based on the methodology presented in the 1997 Highway Capacity Manual⁶.

A primary result of capacity analysis is the assignment of level of service which is a qualitative measure describing operational conditions within a traffic stream and their perception by a motorist or passenger. Level of service generally describes these conditions in terms of such factors as speed and travel time, density or freedom to maneuver, traffic interruptions, comfort and convenience, and safety and, in so doing, provides an index to quality of traffic flow. Six levels of service (LOS) are defined⁷ ranging in letter designation from LOS A to LOS F, with LOS A representing the best operating condition and LOS F representing the worst. LOS C describes a stable flow condition and is considered desirable for peak or design hour traffic flow. LOS D is generally considered acceptable where the cost and impacts of making improvements to provide LOS C are deemed unjustifiable. Level of Service E is capacity.

⁶ 1994 Highway Capacity Manual, Special Report 209, Transportation Research Board, Washington, D.C.

⁷ ibid

Insert Figure 3-16 page 1

Insert Figure 3-17-1

3-17-2

The results of the freeway segment analysis, as summarized in **Table 3-31 and Figures 3-18 and 3-19**, revealed poor operating conditions (LOS E or F) along I-93 from the state line northward to Exit 4. During the 1997 AM peak hour, main line corridor capacity is exceeded (LOS F) in the southbound direction between Exits 3 and 1, and capacity operations (LOS E) exist north of Exit 3 and south of Exit 1. During the 1997 PM peak hour, freeway corridor operations fail (LOS F) northbound between Exits 1 and 3. Capacity conditions (LOS E) exist north of Exit 3, and field observations indicate that the traffic congestion associated with LOS F conditions north of Exit 1 spill back through the interchange area and to the south of Exit 1.

Table 3-31
1997 Existing Conditions Freeway Segment Analysis Summary

Segment	Time Period	Direction	Volume	# Lanes	LOS
MA state line to Exit 1	AM Peak Hour	NB*	2,500	4	B
		SB**	4,955	3	E
	PM Peak Hour	NB	5,520	4	D
		SB	3,405	3	C
Exit 1 to Exit 2	AM Peak Hour	NB	1,925	2	C
		SB	4,105	2	F
	PM Peak Hour	NB	4,140	2	F
		SB	2,765	2	D
Exit 2 to Exit 3	AM Peak Hour	NB	1,495	2	B
		SB	4,530	2	F
	PM Peak Hour	NB	4,490	2	F
		SB	2,455	2	C
Exit 3 to Exit 4	AM Peak Hour	NB	1,355	2	B
		SB	3,530	2	E
	PM Peak Hour	NB	3,510	2	E
		SB	2,145	2	C
Exit 4 to Exit 5	AM Peak Hour	NB	1,750	2	B
		SB	2,785	2	D
	PM Peak Hour	NB	2,820	2	D
		SB	2,395	2	C
North of Exit 5	AM Peak Hour	NB	2,360	2	C
		SB	2,880	2	D
	PM Peak Hour	NB	3,010	2	D
		SB	2,800	2	D

LOS – Level of Service

* NB - Northbound

** SB - Southbound

The poor level of service for 1997 peak hour traffic flow and the congestion associated with the main line capacity between Exits 1 and 3 also extend to interchange traffic operations, as summarized in **Table 3-32**. LOS F conditions exist during the 1997 AM peak hour at the Exit 1 southbound off- and on-ramps, at the Exit 2 southbound off-ramp, and at the Exit 3 southbound on-ramp. Capacity (LOS E) conditions exist at the Exit 3 southbound off-ramp. During the 1997 PM peak hour, interchange breakdowns (LOS F) occur at the Exit 1 northbound on-ramp, at the Exit 2 northbound on- and off-ramps, and at the Exit 3 northbound off-ramp.

Traffic Forecasting

The purpose of this section is to describe the methodology used to develop the traffic volume projections for the study area. Specifically, this section describes the development of the I-93 sub-area traffic demand model that serves as the basis for traffic volumes that are presented in this report.

In 1994, the NHDOT began an important statewide study to carry the Department's transportation planning into the 21st century. The overall goal of the Statewide Planning Study is to "provide recommendations for developing a coordinated transportation system that will facilitate the movement of persons and goods in a safe, cost-effective, efficient, and environmentally conscious manner." Recommendations from this study were to be directed to all transportation modes in the State of New Hampshire, including highways and public transportation.

The New Hampshire Statewide Travel Demand Model System (NHSTMS) was developed as part of this study. The model helps predict travel behavior (i.e., how people travel- by car, bus, etc.) and travel demand (i.e., how many people want to travel on a certain road or by a certain mode). The model is based on statewide data collected on highway, bus, and rail systems; land use, and social and economic characteristics. Household travel, roadside motorist, and transit rider surveys were conducted as part of the data collection effort in 1994. The model is intended to identify potential new or improved transportation services and strategies, in an effort to improve overall transportation services, reduce congestion and improve air quality.

insert 3-18-1

3-18-2

3-19-1

3-19-2

Table 3-32
Interchange Analysis Summary
1997 Existing Conditions

Interchange Movement	Time Period	LOS
<u>Exit 1</u>		
NB off ramp	AM Peak Hour	A
NB on ramp		B
SB off ramp		F
SB on ramp		F
NB off ramp	PM Peak Hour	B
NB on ramp		F
SB off ramp		D
SB on ramp		D
<u>Exit 2</u>		
NB off ramp	AM Peak Hour	B
NB on ramp		B
SB off ramp (weave)		F
(nonweaving vehicles)		E
NB off ramp	PM Peak Hour	F
NB on ramp		F
SB off ramp (weave)		E
(nonweaving vehicles)		D
<u>Exit 3</u>		
NB off ramp	AM Peak Hour	B
NB on ramp		B
SB off ramp		E
SB on ramp		F
NB off ramp	PM Peak Hour	F
NB on ramp		D
SB off ramp		C
SB on ramp		C
<u>Exit 4</u>		
NB off ramp	AM Peak Hour	B
NB on ramp		B
SB off ramp		D
SB on ramp (from E)		C
SB on ramp (from W)		D
NB off ramp	PM Peak Hour	D
NB on ramp		C
SB off ramp		C
SB on ramp (from E)		B
SB on ramp (from W)		B
<u>Exit 5</u>		
NB off ramp	AM Peak Hour	B
NB on ramp		C
SB off ramp		C
SB on ramp		C
NB off ramp	PM Peak Hour	C
NB on ramp		C
SB off ramp		C
SB on ramp		C

LOS – Level of Service

The NHSTMS is a tour-based model system consisting of many sub-models, or components. The system is intended to model travel by auto and transit modes for a summer weekday. The base year of the model is 1990 with analysis capabilities for all forecast years ranging from 1997 to 2020 although years beyond 2020 could be analyzed using extrapolation of socio-economic forecasts.

The I-93 sub-area is one of the sub-models or components of the Statewide model. The I-93 sub-area model is more detailed, that is, it has smaller and consequently more traffic zones and somewhat finer highway networks than the Statewide model. The zones and the highway network for the I-93 sub-area model were developed in consultation with the appropriate regional planning commissions (RPCs), local officials and others. The zones and the network for the I-93 sub-area model are consistent with the Statewide overlapping regional models. All links in the Statewide transportation network which are located in the I-93 sub-area are included in the model. The zones are subsets of the Statewide model zones and consistent with the zones in overlapping regional models.

The trip tables for the I-93 sub-area model were developed from the Statewide model. These trip tables were imported into the sub-area model and then traffic assignments were made for the sub-area. The 1997 base year sub-area model was considered to be calibrated when the traffic assignments reasonably reflected the actual traffic volumes recorded by the NHDOT in 1997 on I-93 from the State line to the I-93 and I-293 split in Manchester. **Table 3-33** provides a comparison of the actual 1997 AADT's to the sub-area model traffic assignments for I-93.

Table 3-33
Comparison of 1997 AADT's to Sub-Area Model Traffic Assignments

<u>Roadway</u>	<u>Location</u>	<u>1997 AADT*</u>	<u>1997 Model Assignment*</u>	<u>Percent Difference</u>
I-93	North of Exit 5	68,000	69,300	+ 2%
	Between Exit 4 and 5	59,000	64,900	+ 10%
	Between Exit 3 and 4	63,900	61,800	- 3%
	Between Exit 2 and 3	78,000	74,900	- 4%
	Between Exit 1 and 2	80,000	81,100	+ 1%
	South of Exit 1	101,700	104,400	+ 3%

* Volumes expressed in vehicles per day.

Based on the guidelines published in the Federal Highway Administration's Report *Calibration and Adjustment of System Models*⁸, the 1997 sub-area model traffic assignments, with the exception of the segment between Exits 4 and 5, fall within the 7 percent margin of acceptable modeling error recommended for freeways. Similarly, the sub-area model assignments for other major roadways such as NH 28, NH 111, and NH 102 were also compared to actual 1997 data and were determined to be within the recommended margins of error for these types of facilities. Therefore, with the model calibrated, it was determined that the 1997 sub-area model accurately reflects the actual traffic volume conditions within the project area and could be used for planning and forecasting purposes.

Traffic forecasts were made for year 2020 for the I-93 sub-area using the model. The 2020 highway network includes proposed improvements (expected to be completed by 2020) such as the I-293 widening, the Manchester Airport Access Road, the Nashua Circumferential Highway, and the F.E. Everett Turnpike (FEET) expansion. Traffic forecasts from the I-93 subarea model were compared with traffic forecasts for 2020 from the Southern New Hampshire Planning Commission model, the Manchester Airport Access Model, the Windham-Salem NH 111 model, and the Nashua Regional Planning Commission model and correlation's were found to be acceptable.

As shown in **Table 3-34**, the 2020 ADT for the I-93 No Build condition along the corridor ranges from a low of approximately 73,000 vpd between Exits 3 and 4 to a high of approximately 137,000 vpd south of Exit 1. The DHV ranges from approximately 6,900 vph to 12,900 vph. Similarly, the DDHV ranges from approximately 4,100 vph to approximately 7,700 vph. Overall traffic volume increases are expected to range between 17 percent and 31 percent with the higher increases occurring south of Exit 3.

Table 3-34
1997 & 2020 Average Weekday and Design Hour Volumes (No Build)

Segment	ADT*	1997		ADT*	2020	
		DHV**	DDHV***		DHV**	DDHV***
North of Exit 5	69,300	6,500	3,900	84,300	7,900	4,800
Between Exits 4 and 5	64,900	6,100	3,700	81,200	7,600	4,600
Between Exits 3 and 4	61,800	5,800	3,500	73,000	6,900	4,100
Between Exits 2 and 3	74,900	7,000	4,200	98,000	9,200	5,500
Between Exits 1 and 2	81,100	7,600	4,600	103,600	9,700	5,800
South of Exit 1	104,400	9,800	5,900	137,000	12,900	7,700

*ADT – Average Daily Traffic

** DHV - Design Hour Volume

***DDHV - Directional Design Hour Volume

⁸ Calibration and Adjustment of System Models, Federal Highway Administration, December 1990.

3.19.3 Accident Statistics

Accident statistics compiled by the New Hampshire Department of Transportation are based on information provided by the New Hampshire Department of Safety (NHDOS) and is only as accurate as what is reported to the NHDOS. Statistics for the five-year period of January 1995 through December 1999 (partial year 1999 NHDOS file not complete) were reviewed. The accident data for the study area, which extends from the Massachusetts state line to Interstate 293, revealed a total of 1,227 accidents during the five-year period. A summary of the accident data is presented in **Table 3-35**.

Table 3-35
Accident Summary (January 1995 – December 1999)

<u>Location</u>	<u>Property Damage Only</u>	<u>Personal Injury</u>	<u>Fatal Accident</u>	<u>Total</u>
From MA state line to Exit 1	54	41	1	96
At Exit 1	7	5	0	12
From Exit 1 to Exit 2	64	39	3	106
At Exit 2	14	3	0	17
From Exit 2 to Exit 3	99	59	1	159
At Exit 3	17	2	0	19
From Exit 3 to Exit 4	259	112	4	375
At Exit 4	16	6	0	22
From Exit 4 to Exit 5	111	49	2	162
At Exit 5	14	5	0	19
From Exit 5 to I-293	110	86	4	200
At I-293	7	4	0	11
<u>Unknown</u>	<u>29</u>	<u>0</u>	<u>0</u>	<u>29</u>
Total	801	411	15	1227

Year:

1995	253
1996	236
1997	203
1998	292
<u>1999</u>	<u>243</u>
Total	1227

Month:

January	137
February	92
March	142
April	85
May	118
June	112
July	88
August	100
September	86
October	88
November	90
<u>December</u>	<u>89</u>
Total	1227

Surface Condition:

Dry	866
Wet	144
Snow/Ice	201
Debris	2
<u>Unknown/Other</u>	<u>14</u>
Total	1227

Although caution should be applied when attempting to relate accident trends to potential causation, the following trends have been identified.

- The segment of I-93 between Exits 3 and 4 recorded the highest number of accidents with 375 accidents (31 percent). Two hundred accidents (16 percent) were recorded between Exit 5 and I-293. The segments between Exits 4 and 5, and between Exits 2 and 3 recorded 162 accidents (13 percent) and 159 accidents (13 percent), respectively. The segments between Exit 1 and Exit 2, and between the MA state line and Exit 1 recorded the fewest accidents with 106 (9 percent) and 96 (8 percent) respectively. The number of accidents that occurred at each of the interchanges range from a low of 11 at I-293 to a high of 22 at Exit 4.
- The roadway surface condition was recorded as dry for 866 accidents (71 percent), snow or ice for 201 accidents (16 percent), and wet for 144 accidents (12 percent). Two accidents were related to debris in the roadway. The road condition for the remaining 14 accidents are unknown.
- Of the total 1,227 accidents, 801 (65 percent) were limited to property damage only, while 411 accidents (33 percent) resulted in personal injury. Fifteen accidents (1 percent) resulted in a fatality. Of note, 13 of the 15 fatal accidents involved only a single vehicle.
- The number of accidents that occurred between 1995 and 1997 revealed a steady decline with the number of accidents each year recorded at 253, 236 and 203 respectively. However, the trend was broken in 1998 when 292 accidents – the highest during the five-year period – were recorded. The number of accidents again declined in 1999 with 243 accidents reported.
- The month of March recorded the highest number of accidents with 142. The next four highest months were January, May, June, and August with 137, 118, 112, and 100 respectively. The incidence of accidents tends to be lower during the Fall season or the months of September through December.

3.19.4 Geometric Deficiencies

This section summarizes the geometric deficiencies that currently exist along the I-93 segment under study. These deficiencies were identified by comparing the existing horizontal and vertical geometry with desirable conditions listed in *A Policy on*

*Geometric Design of Highways and Streets*⁹, (AASHTO) for the same type of highway facility and based on current NHDOT standards.

I-93 is a major link in the interstate system and functions as a principal arterial interstate highway, also referred to as a freeway. Access to this facility within the study area, is only available from the five interchanges spaced along the corridor. The connecting roadways at each interchange function as minor arterials, which serve as links between the larger towns and smaller cities. Four types of facilities were identified for establishing design criteria for comparison and evaluation. These facilities and some of the corresponding design criteria are shown in **Table 3-36**.

⁹ American Association of State Highway and Transportation Officials, A Policy on Geometric Design of Highways and Streets, Washing, D.C.

TABLE 3-36
ROAD DESIGN CRITERIA

	Proposed Roadways			
	Local Road	Arterials	Ramps	Freeways
Design Speed	40 mph	40-50 mph	50 mph (at nose) 30 - 40 mph (on-ramp)	70 mph
Maximum Grade	8%	5% desirable	4% desirable	4% desirable
Minimum Grade	0.5%	0.5%	0.5%	0.5%
Superelevation	4% maximum	8% maximum, 4% max. @ intersections	6% maximum	8% maximum
Vertical Curves	AASHTO minimum or better	AASHTO minimum or better	AASHTO minimum or better	AASHTO minimum or better
Lane Width	11 ft. minimum 12 ft. desirable	12 ft.	16 ft.	12 ft.
Shoulders	4 ft. minimum	4 ft. minimum	10 ft.	10 ft.
Access Control	None	Control desirable	Control required	Control required
Intersection/ Interchange Spacing	600 ft. desirable	0.25 mile desirable		1.0 mile urban 2.0 mile rural
Structures Criteria				
Minimum Vertical Clearance: <ul style="list-style-type: none"> • 16 ft.-6 in. over major roadways • 14 ft.-6 in. over minor roadways • 22 ft.-6 in. over railroads • minimum grade 1% 				

The following is a summary of the deficiencies that were found within the existing roadway geometry based on current AASHTO and NHDOT standards.

I-93 Mainline

South of Exit 1 - the Rest Area/Welcome Center has a less than desirable length for the deceleration lane and on and off ramp geometry that will only accommodate a 30 mph design speed.

Between Exits 1 and 2 - the southbound barrel has a grade of 4.5% between Brookdale Road and Pelham Road.

Between Exits 2 and 3 - there are no geometric deficiencies along the I-93 mainline.

Between Exits 3 and 4 - both the southbound and northbound barrels have grades as steep as 5%. There is also a short stretch of roadway, north of Lowell Road, which has a flat grade of less than the minimum desirable 0.5%.

Between Exits 4 and 5 - there are no geometric deficiencies along the I-93 mainline.

Between Exit 5 and the I-93/I-293 split in Manchester – flat grades of less than the desirable 0.5% exist along the I-93 mainline, both northbound and southbound, near Bodwell Road. In addition, the tapers for creating the split between I-93 and I-293 are short and abrupt, but are being addressed as part of the project to rehabilitate the bridges carrying I-93 over Bodwell Road and Cohas Brook.

Interchanges

Exit 1 - consists of a three-legged, trumpet type interchange.

- SB On ramp
 - Two on ramp lanes converge with two I-93 travel lanes and taper to three thru lanes at a rate of 50:1 (70:1 desirable).
- SB Off ramp
 - 300' parallel deceleration length (less than desirable)
 - SB Off ramp radii at 180' (<30 mph design)
- NB On ramp
 - 30:1 Acceleration Taper (50:1 desirable)

Exit 2 is a partial cloverleaf/partial diamond interchange.

- The southbound direction poses a problem for traffic trying to exit the highway while traffic is trying to enter the highway in such a short distance. This short weaving section is less than the desirable length required to accommodate the traffic.
- Minimal spacing between SB ramps intersection and Keewaydin Drive.
- NB Off ramp
 - 400' long parallel deceleration length
- NB On ramp
 - 25:1 acceleration taper (50:1 desirable)
- Steep grade from NB on-ramp (4%) transitioning into grade of I-93 NB (3 %) creates difficulty for trucks to merge into I-93 NB traffic.

Exit 3 is a half-cloverleaf interchange. The SB Off and NB On ramps are loop ramps.

- SB Off ramp

- Vertical Curve at the nose has a $K_{\text{crest}} = 97$ (45 mph design speed / 50 mph desirable)
- SB Off ramp grade of 5% (the downgrade coupled with the horizontal curvature makes this ramp geometry still less desirable).
- NB On ramp
 - 45:1 acceleration taper with a 4' shoulder. (desirable is 50:1 taper with a 10' shoulder)
 - Steep grade from NB on-ramp (4%) transitioning into grade of I-93 NB (3%) creates difficulty for trucks to merge into I-93 NB traffic.
- NH-111
 - Steep grade of 4.9% between I-93 NB and I-93 SB (>4% assumed steep for arterial type where traffic may be stopped on approach to intersection)

Exit 4 is a full diamond interchange with a free flow loop ramp that connects NH 102 Westbound to I-93 Southbound.

- NB On ramp
 - Acceleration lane has a 4' shoulder (standard is 10' at nose of on ramp)
- NH-102
 - Steep grade of 6% (>4% assumed steep for arterial type where traffic may be stopped on approach to intersection)

Exit 5 is a full diamond interchange.

- All ramps are relatively short, resulting in traffic queues extending onto the I-93 mainline.
- SB On ramp
 - Acceleration lane has a 4' shoulder (standard is 10' at nose of on ramp)
Acceleration lane taper is approximately 35:1 (less than desirable 50:1).
- SB Off ramp
 - 250' long parallel deceleration length (less than desirable)
- NB Off ramp
 - 250' long parallel deceleration length (less than desirable)
- NB On ramp
 - 45:1 acceleration taper with a 4' shoulder (desirable is 50:1 taper with a 10' shoulder)
 - Vertical Curve at the nose has a 35 mph design speed (50 mph desirable).

3.19.5 Infrastructure Deficiencies

The existing highway was originally built in the 1960's and since that time, the facility has not undergone any major upgrades within the study area. There have been two capacity improvements along this segment of I-93 since its original construction, which includes some widening in the northbound direction south of Exit 1 to accommodate traffic for the Mall at Rockingham Park in 1990, and, also in 1990, reconstruction of the Exit 4 Interchange. The Rest Area just south of Exit 1 was also reconstructed in 1993. Currently, the weigh stations just north of Exit 3 are being reconstructed and expanded.

In addition to the existing geometric deficiencies identified above, a number of infrastructure deficiencies have also been identified.

Roadway

Some of the existing roadway infrastructure deficiencies, (specifically, outdated cable guard rail, deteriorating drainage systems and pipes, and deteriorating pavement) are a direct result of the age of the facility. The NHDOT is currently in the process of replacing the outdated cable guard rail system as part of a safety upgrade along this segment of I-93. The existing pavement surface requires rehabilitation and it is expected that subsurface analysis will indicate that roadway base materials will require rehabilitation over much of the highway length.

Bridges

There are 55 bridges within the study area including bridges on secondary roads adjacent to I-93 that fall within the study limits. Within the past ten years, five of these bridges have been replaced, five have been rehabilitated and widened, and another four are just about to begin construction for rehabilitation and widening. The most recent bridge construction projects have been completed with the future widening in mind, to hopefully minimize the need for additional construction as part of any potential widening resulting from this study.

Of the 55 bridges, 18 are considered to be in, or approaching, "red list" condition (indicating the need for replacement or substantial rehabilitation of these), 13 have been identified as structurally deficient and two have been classified as functionally obsolete. In addition, 13 bridges do not meet NHDOT minimum vertical clearance criteria.

3.19.6 High Occupancy Vehicle (HOV) Facilities

Currently there are no high occupancy vehicle (HOV) lanes in New Hampshire on any facilities and none within the 18-mile segment of I-93 under study. There are two park-and-ride lots which serve carpools/vanpools and commuter bus operations. These are described in the Transportation Demand Management section. Massachusetts also has no HOV lanes on I-93 south of the New Hampshire border in northern Massachusetts. The Merrimack Valley Planning Council recently issued a Request for Proposal for an I-93 Corridor Traffic Study in Methuen and Andover that will include consideration of an HOV facility.

With respect to an HOV lane located on I-93 as it approaches Boston, a study done in 1994 by the Massachusetts Highway Department to consider extending the existing southbound HOV lane north from the Charles River Crossing to the I-93/I-95/MA 128 Interchange concluded that the project would attract too many additional HOV's. The HOV lane is currently operating near capacity and encouraging more HOVs would be counter productive. The study underscored the sensitive balance required in HOV volume.

3.19.7 Transportation Demand Management

Transportation Demand Management (TDM) encompasses a variety of strategies that are designed to change personal travel behavior to reduce the demand for automobile use and the need for highway capacity expansion. This is accomplished through measures that reduce the number or length of trips or that move trips out of times of peak roadway congestion. TDM measures include conventional transportation services such as bus service, rail service, and providing park and ride lots, as well as lesser known strategies such as work hour management, parking restrictions, and congestion pricing.

TDM programs are frequently targeted at work trips because commuters account for most peak-hour travel (generally the periods of greatest roadway congestion) and because work trip patterns are generally consistent from day-to-day. TDM programs that currently exist in the I-93 corridor are promoted at least in part through the NHDOT, the Rockingham Planning Commission and the Manchester Airport Transportation Management Association (TMA). In addition, several TMA's operating in Massachusetts provide TDM programs that serve residents of New Hampshire.

3.19.7.1 *Park-and-Ride Lots*

To support those who travel by carpool, vanpool or bus, the NHDOT officially recognizes a number of park-and-ride lots (not all are owned and maintained by the

NHDOT) (see **Table 3-37**). A number of these serve drivers who use the I-93 corridor between Manchester and the New Hampshire/Massachusetts state line. The NHDOT is considering efforts to develop additional park-and-ride facilities that would serve the corridor.

Existing Park-and-Ride Lots

The park-and-ride lots that serve users of I-93 in the study area are listed in **Table 3-37**. All are along I-93, either in the study area or to the north, and along I-89. Only the lots in Concord and Londonderry located along I-93 are served by bus. They are the largest lots with 744 of the total of 1,269 spaces (58%) provided in all the lots. They are generally the most heavily utilized.

Table 3-37
New Hampshire Park-and-Ride Lots¹⁰

Town	Location on	Number of Spaces	Occupancy Counts (8/98)	Occupancy Counts (10/99)	Services
I-89 Corridor					
New London	Exit 12, NH 103A	45	19	13	L, S, T
Warner	Exit 9, NH 103	20	10	11	L, T
Concord	Exit 2, NH 13 (Clinton Street)	100	31	48	P, L
I-93 Corridor					
New Hampton	Exit 23 East, NH 104	15	7	10	
Tilton	Exit 20, US 3 East	63	5	27	L, T
Boscawen	Exit 17, US 4	27	22	24	L
Concord*	Exit 14, Stickney Avenue	273	268	196	P, L, S, T*
Bow	Jct. of I-89 and I-93, NH 3A	60	38	60	P, L
Hooksett	Exit 11, Hackett Hill Road	45	23	8	L
Londonderry*	Exit 4, NH 102	471	389	406	P, L, S, T*
Windham	Exit 3, NH 111	150	46	67	L, S
Total		1,269	858	870	

P = Phone; L = Lighting; S = Shelter; T = Bus Transit; T*This lot is served by Concord Trailways, which provides the commuter transit service in the corridor.

Proposed Park-and-Ride Lots

The park-and-ride lot in Windham was upgraded in 1998 to further encourage travelers to use the facility. The lot is located on NH 111 approximately 0.8 miles west of I-93 at an unsignalized intersection. It was previously served by bus transit to Boston; however, this

¹⁰ Occupancy counts for Londonderry and Windham were provided by the Rockingham Planning Commission. All other counts are from NHDOT, and most were completed in August of 1998. NHDOT usually does regular counts in October and finds that those completed in August tend to be lower, due to summer vacations. The count for the Bow lot in July 1999 was a random count.

service was curtailed due to the lack of customers and the delay buses experienced accessing the lot.

The NH 111, Windham-Salem Final Environmental Impact Study (FEIS) recommended that, as part of a separate project, consideration should be given to developing a new park-and-ride facility at I-93, Exit 3 with access from NH 111 and possibly direct access onto and off of I-93. The lot would be located between the I-93 northbound and southbound lanes on the south side of NH 111. As proposed, the site location would enjoy improved access and higher visibility. The feasibility of this lot is contingent on further study of the I-93 corridor.

Consideration is also being given to a new park-and-ride lot in Salem that would provide parking for bus transit service between the Windham/Salem area and Boston. The Salem-Plaistow-Windham MPO submitted a CMAQ proposal in 1998 for a lot that would accommodate ride-sharing and intercity bus service, and would be located off Rockingham Park Boulevard near Exit 1 in Salem. Current plans include 460 parking spaces and a bus station with rest rooms, phones, lighting, bike racks, trash receptacles, landscaping, and signage on I-93. Acquisition of the site has been accomplished by NHDOT, and preliminary designs developed. Permitting issues involving prime wetlands have delayed efforts to complete the design and construct the facility.

Outside of New Hampshire, a park-and-ride lot is planned for Methuen, Massachusetts. The lot was programmed for 1999, but is currently awaiting a notice to proceed for construction (as of January 2000). Located off I-93 on Pelham Street (Exit #47), the lot will contain 188 parking spaces for commuters who carpool/vanpool and provide a potential terminus for commuter bus service to Boston. Planned amenities include a shelter, bike racks, wooden benches, trash receptacles, lighting, landscaping and signage on I-93.

3.19.7.2 Ride-matching

The NHDOT operates a Statewide Ride-Share Program through its Bureau of Rail and Transit. The program is approximately three years old and has not yet built a substantial database. There are currently about 300 people registered for ridematching but only about 18 carpools are known to have been formed through the program statewide.

The state's Ride-Share Coordinator also promotes ridesharing through individual employers by sponsoring transportation events, providing marketing materials, and encouraging employers to adopt TDM strategies such as guaranteed ride home programs, parking management, flextime, and telecommuting. In this process, the state mainly targets rural areas, and depends on the Regional Planning Commissions to work with employers in the urbanized areas.

The Rockingham Planning Commission (RPC) also promotes ridematching through the state's Ride-Share Program. Two years ago the RPC conducted an extensive outreach to approximately 25 targeted employers, trying to educate them about TDM opportunities and encourage them to implement programs. As part of its TDM efforts, the RPC produced a "Transit Guide" for the Salem, Plaistow, and Windham area to promote the use of transit. This guide provides information on all intercity (interstate) bus service, Massachusetts commuter rail service, carpool and vanpool matching services, and health and human service transportation options in the region.

Massachusetts based CARAVAN for Commuters also provides ride-matching services for New Hampshire residents who work in Massachusetts and Massachusetts residents who work in New Hampshire. CARAVAN currently has 14 vanpools that travel in the I-93 corridor from Manchester, Londonderry, Windham, Salem, and Plaistow to Boston.

3.19.7.3 *Transportation Management Association Initiatives (TMA)*

The Manchester Airport TMA was formed in 1994 with CMAQ funds to mitigate traffic impacts associated with airport activity. It is now totally supported by its members, which include the municipalities of Manchester and Londonderry, the Manchester Airport, the Manchester Transit Agency, the Manchester Chamber of Commerce, Blue Cross Blue Shield, United Parcel, Felton Brush, Inc., Freudenberg-NOK, Acu-Pak, Mack's Apples, and Stonyfield Farm.

The TMA offers a full range of TDM programs and has formed 20 carpools at Blue Cross Blue Shield following its relocation from Concord. Member programs include:

- GIS-based ride-matching for carpools and vanpools
- Information about private bus routes and local bus service providers
- Guaranteed ride home program for employees
- Preferential parking for carpools and vanpools
- Employer consultations regarding transportation and commuting issues
- Employee Transportation Coordinator training
- Quarterly commuter newsletter
- Marketing materials
- Transportation awareness events
- Consultations regarding telecommuting and flexible work arrangements

Massachusetts has a number of TMAs that provide a full range of services to many New Hampshire residents who work along the I-93 corridor and in Boston. The Massachusetts TMAs that have the greatest likelihood of influencing travel on the I-93 corridor in the study area are:

- The River Road TMA in Andover
- The currently forming Ballardvale Street/Lowell Junction TMO (Transportation Management Organization) in Andover and Wilmington
- The Artery Business Committee TMA in Boston
- Commuter Works/MASCO in Boston (Longwood Medical and Academic Area)
- The Interinstitutional TMA in Boston (Boston Medical Center)
- The Logan TMA at Logan Airport
- The Seaport TMA in South Boston
- The Charles River TMA in Cambridge
- The 128 Business Council TMA

The River Road TMA in Andover estimates that approximately 25 percent of the employees from its member companies live in New Hampshire. As a result, all of its ride-sharing services, which are available to all employees, serve New Hampshire residents. These include ride matching and Guaranteed Ride Home programs. Further, as described in Proposed Bus Transit Service section below, the Merrimack Valley Regional Transit Authority (MVRTA) has applied for CMAQ funding through the Massachusetts Highway Department to initiate express bus service from southern New Hampshire to the River Road employment area. Many members of Boston TMAs provide support for vanpools and transit ridership, which benefit New Hampshire residents traveling to Boston.

3.19.7.4 Bus Transit Services

No publicly owned bus transit service exists in the I-93 corridor. However, Concord Trailways, a private bus carrier, provides commuter service between southern New Hampshire and Boston. Concord Trailways operates two routes in the I-93 corridor that offer commuter oriented service between southern New Hampshire and Boston, as well as Logan Airport oriented service that extends into northern New Hampshire. Service provided is as follows:

Concord-Manchester-Boston-Logan Airport

Southbound, daily, weekday service includes 18 trips that depart from Concord or Manchester between 5:00 AM and 6:00 PM. There are seven trips that pass through the study area during the morning peak commuting period. Scheduled travel time from Manchester to South Station in Boston for these peak period trips varies between one hour and ten minutes, and one hour and thirty minutes. The longest trips include a stop in Londonderry.

Northbound, daily, weekday service 17 trips that depart Logan or Boston for Manchester between 3:15 AM and 9:25 PM. There are seven trips that pass through the study area during the evening peak commuting period. Scheduled peak period travel times from South Station to Manchester varies between one hour, and one hour and fifteen minutes.

Fares between Concord and South Station are \$12.00 one way, \$23.00 round trip and \$61.00 for a commuter weekly pass. Fares between Manchester and South Station are \$9.50 one way, \$18.00 round trip and \$54.00 for a commuter weekly pass.

Londonderry-Boston

Southbound, daily, weekday service includes 8 buses that depart Londonderry between 5:40 AM and 8:50 AM. Scheduled travel times vary between 50 minutes, and one hour and ten minutes.

Northbound, daily, weekday service includes 10 buses that depart Boston between 1:00 PM to 8:15 PM. Scheduled travel times vary between fifty-five minutes and one hour.

Fares between Londonderry and South Station are \$8.50 one way, \$16.50 round trip and \$51.00 for a commuter weekly pass.

Additional Bus Service Along I-93

Three additional Concord Trailways routes provide less frequent service from more northern towns in New Hampshire. This service is oriented toward travel to Logan Airport and includes:

- Laconia-Tilton Jct.-Concord-Manchester-Boston-Logan Airport
 - Southbound, daily, weekday service operates between 7:00 AM and 4:00 PM and provides two AM and one PM bus.
 - Northbound, daily, weekday service operates between 9:15 AM and 7:25 PM and provides one AM and four PM buses.
- Berlin-Conway-Meredith-Boston-Logan Airport – provides one trip each way daily on weekdays with one additional trip on Fridays.
- Littleton-Lincoln-Plymouth-Boston-Logan Airport – provides one trip each way daily on weekdays with additional service when Plymouth State College is in session.

Existing Ridership

Table 3-38 presents annual ridership for various segments of Concord Trailways bus routes that serve the southern New Hampshire to Boston market. These routes use the I-93 corridor through the project study area. Annual ridership on Concord Trailway's Manchester/Londonderry south routes during 1999 was 265,000 passengers. An additional 115,000 passengers utilized Concord Trailways services originating from Concord south. Services north of Concord carried 45,000 passengers. In total, southern

New Hampshire bus services accounted for an estimated 425,000 passengers. None of these services provided interim stops within Massachusetts.

Table 3-38
1999 Concord Trailways I-93 Corridor Ridership

Origin	Ridership
North of Concord	45,000
Concord South	115,000
Manchester/Londonderry South	265,000
Total	425,000

On February 28, 2000 Concord Trailways surveyed their riders to determine the communities from which it draws its ridership. Surveys were conducted in Londonderry and in Manchester.

Two hundred forty two (242) surveys were tabulated from passengers using the service from Londonderry. Eighty-five (35 percent) of the survey respondents indicated that they lived in Londonderry. An additional seventy-seven respondents (32 percent) were from Derry and the remaining 33 percent came from a number of other surrounding communities.

One hundred twenty six surveys were collected from passengers boarding in Manchester. Nearly two-thirds of the respondents (84) were from Manchester with the remaining respondents coming from several other surrounding communities.

Proposed Bus Transit Service

Intercity bus transit between Windham/Salem and Boston was funded in the Fiscal Year 1994 Transportation Improvement Program for the region. Concord Trailways was selected to provide this service, which would offer six round trips daily. However, implementation of this service is on hold pending the construction of a park-and-ride lot in Salem.

Currently, all existing commuter oriented bus service between New Hampshire and Massachusetts is targeted at the Boston commuter and does not serve destinations north of downtown Boston in Massachusetts. To meet the existing demand for this type of service, the Merrimack Valley Regional Transit Authority (MVRTA) in Massachusetts has recently applied for CMAQ funding through the Massachusetts Highway Department to initiate express bus service from southern New Hampshire to the River Road employment area in Andover. This bus service could potentially make stops at the Hooksett, Londonderry and Windham park-and-ride lots on I-93 in New Hampshire to provide commuter service to River Road area employers. MVRTA is coordinating its

planning and funding efforts with the NHDOT and the three Regional Planning Commissions in Southern New Hampshire.

3.19.7.5 Rail Transit Services

Passenger Rail

Three potential corridors have been identified for the evaluation of passenger rail transportation as part of the I-93 study. Corridors to be evaluated include the former B&M New Hampshire Main Line (West Rail Corridor) west of I-93, the former B&M Manchester & Lawrence Branch (East Rail Corridor) east of I-93, and a new rail line within the I-93 highway corridor (I-93 Rail Corridor) shown on **Figure 3-20**.

The southern New Hampshire region is home to many people who work in the metropolitan Boston area. The two major highway routes from this region to the Boston area are US 3 (the F.E. Everett Turnpike in New Hampshire) and I-93. The West Rail Corridor generally parallels US 3 between Manchester and Lowell and the East Rail Corridor generally parallels I-93 between Manchester and Salem. Both rail corridors connect with existing MBTA commuter rail lines.

West Rail Corridor

The **West Rail Corridor** extends 30 miles from Manchester through Bedford, Merrimack, and Nashua to Lowell, Massachusetts. In the past, passenger rail service was operated by the Boston & Maine Railroad from Concord, Manchester, and Nashua to Boston. The B&M terminated passenger rail service in June 1967. In January 1980, the MBTA and NHTA inaugurated a demonstration project that offered commuter rail service between Boston and Nashua, Manchester, and Concord. This 13-month program was funded by a federal grant through the United States Department of Transportation. The service reached a peak of 240-250 daily round trips on a schedule that offered a travel time in excess of two hours from Concord to Boston. The demonstration project fulfilled its purpose by identifying the latent demand for rail service in southern New Hampshire. It was discontinued when the funding for the demonstration project was expended.

At present, daily freight traffic is provided along the line by Springfield Terminal Railway (Guilford Transportation Industries). Service from Lowell to Nashua Yard consists of main line and local freight trains, as well as “unit coal” trains that head north to Bow, NH. Train service north of Nashua consists of trains serving local industries or the unit coal trains serving Bow. Mainline through freight trains also operate between Nashua and Boston in the late evening or very early morning hours. In March 1999, GTI was operating the unit coal train to Bow three days a week. Local freight service was operated daily from the

Insert Figure 3-20

Nashua Yard south to service customers located along the line to Lowell. Similarly, local freight service was offered daily from Nashua to the north.

East Rail Corridor

The **East Rail Corridor** extends from Manchester through Londonderry, Derry, Windham, and Salem to Lawrence, Massachusetts. The 28-mile corridor is the former B&M Manchester & Lawrence Branch. In the past, when offered, passenger service along the M&L was always limited because of the light population density along the line and the use by the B&M of the New Hampshire Main Line as the preferred through route from Manchester to Boston. Regularly scheduled passenger rail service along the route was discontinued by the B&M in July, 1953. Special passenger trains continued to operate from Boston to Rockingham Park on race days until September 1961.

Today, the M&L Branch sees some limited activity serving freight rail customers between Lawrence and Salem. On the south end, a single track exists from Lawrence to Rockingham. Guilford Rail System operates the infrequent local freight service to the few remaining rail customers. North of Rockingham, the track has been removed for a thirteen-mile section from Windham to Londonderry and the corridor is owned by the NHDOT, but is used as a recreational trail under the control of New Hampshire Department of Resources and Economic Development (NHDRED). From Londonderry to Manchester, the track has been removed and the railroad right-of-way in areas has been sold.

I-93 Rail Corridor

The basic **I-93 Rail Corridor** alignment to be considered as part of the I-93 study extends 20.5 miles from Exit 5 in Londonderry to the Massachusetts state line. The alignment is intended to follow within, or adjacent to, the existing I-93 corridor or the alignment could continue into Massachusetts along the I-93 Corridor to serve industrial areas along I-93. At the state line, the rail alignment would leave the I-93 right-of-way and connect into the M&L corridor. Potential stations could be located at Exit 5 in Londonderry, Exit 4 in Derry, Exit 3 in Windham, and Exit 1 or 2 in Salem. The alignment most likely would be located in the median area of I-93.

Current Rail Initiatives

Passenger (commuter) rail service is not currently operated into southern New Hampshire. Residents of this area have the option of driving to Massachusetts and parking at existing MBTA stations. In the Winter of 2000-2001 the Northern New England Passenger Rail Authority anticipates the start of Amtrack passenger rail service between Portland, Maine and Boston. This service will include stops in Exeter, Dover, and Durham.

Over the past two decades, a number of studies have been conducted examining the feasibility of passenger (commuter) rail service between the southern New Hampshire region and Boston, Massachusetts. These studies include:

- "New Hampshire Rail Passenger Demonstration Program", New Hampshire Transportation Authority, 1981
- "Salem Commuter Rail Study", Rockingham Planning Commission, 1984
- "The Southern New Hampshire and Northern Middlesex Commuter Rail Preliminary Feasibility Study", Guilford Transportation Industries, January 1986 (Revised November 1986)
- "Passenger Rail Feasibility Study for the Nashua Area", Nashua Regional Planning Commission, 1988
- "The Passenger Rail Feasibility Study Phase II: Development of Implementation Strategies", Nashua Regional Planning Commission, 1990
- "Commuter Rail Feasibility Study for Manchester NH", prepared for the Southern New Hampshire Planning Commission by Vanasse Hangen Brustlin, Inc., August 1994
- "Technical Memorandum – NHRRA Rail Proposal (I-93 Corridor Commuter Rail)", Salem-Plaistow-Windham MPO Technical Advisory Committee, May 1997 (Revised June 1997)
- "Major Investment Study – Nashua Passenger Rail Service", Nashua Regional Planning Commission, June 1999

The most recent of these studies completed by the NRPC in June 1999 documents an incremental approach to the restoration of service along a 30.6-mile section of the former B&M New Hampshire Main Line (NHML) rail corridor between Lowell and Manchester (West Rail Corridor). The approach examined by the NRPC considers a two-phase program to restore passenger service. Phase 1 would include an extension of service from the existing MBTA terminus in Lowell to a new park and ride station located adjacent to the F.E. Everett Turnpike at Exit 2 (Sagamore Bridge) in Nashua. The Phase 1 effort would extend service approximately 11 miles. For Phase 2, the NRPC is considering a further extension of the service from Nashua to Manchester a distance of 19 miles. Within this 19-mile segment, three potential station sites are being considered: Star Drive in Merrimack, the proposed Airport Connector Road in Bedford, and Granite Street in Manchester. Each of these station sites could be considered as an interim terminus of service, if additional incremental phases of work are necessary. The Major Investment Study (MIS) estimates daily boardings of approximately 900 passengers at the Nashua station. If there were a Nashua and Merrimack station, the estimated daily boardings are projected to be 750 in Nashua and 250 in Merrimack.

Other possible locations to reintroduce rail passenger service into New Hampshire include service between Plaistow, NH and Lawrence MA; and between Portsmouth, NH

and Newburyport, MA. Once in Massachusetts, passengers would be able to continue on to Boston. Coordination between New Hampshire and Massachusetts officials is ongoing. Major hurdles to overcome include finding the necessary funding to make infrastructure improvements in both states.

The project to restore passenger service between Nashua and Lowell is moving forward independent of the I-93 widening project. Funding for developing preliminary plans, evaluating the environmental impacts, developing an operating plan, and finalizing the project parameters is available and the work efforts will be underway in the near future.